NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

PROJECTING OFFICER STRENGTH OF THE UNITED STATES ARMY RESERVE FROM 2008-2012

by

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June 2008

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REPORT DOCUMENTATION PAGE	*Form Approved OMB No. 0704-0188*

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE June 2008	3. REPORT TYPE AND DATES COVERED Master's Thesis

4. TITLE AND SUBTITLE Projecting Officer Strength of the United States Army Reserve from 2008-2012

5. FUNDING NUMBERS

6. AUTHOR(S) Jonathan J. Pontius

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Naval Postgraduate School
Monterey, CA 93943-5000

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES)
N/A

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT (maximum 200 words)

As the Army continues to fight in Afghanistan and Iraq, its steady need for Reserve Component Soldiers has impacted the ranks of the Army Reserve. The officer ranks are experiencing critical shortages in the ranks of captain and major. The Army Reserve's goal over the next five years is to not only eliminate the officer shortages, but to also increase the number of officers in its ranks. This thesis applies a combination of projection techniques to historical data for officer strengths, accessions, promotions, and losses to predict what the Army Reserve officer strengths of second lieutenant through lieutenant colonel will be over the next five years barring any administrative actions. The first finding is that second lieutenant strength is not projected to drop below its 2007 total between 2008 and 2012. The second finding is that the maximum values of the projected endstrengths show no gains through 2012. The recommendation is that the Army Reserve reviews all current officer positions. Possible actions are to keep a position as it is, permanently combine certain duties from a group of positions into fewer positions, cut a position, or reassign a position to either another rank or a civilian position.

14. SUBJECT TERMS
Manpower, Forecasting, Moving Average, Exponential Smoothing, Holt smoothing

15. NUMBER OF PAGES
93

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UU

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18

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PROJECTED OFFICER STRENGTH OF THE UNITED STATES ARMY RESERVE FROM 2008-2012

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Submitted in partial fulfillment of the
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MASTER OF SCIENCE IN OPERATIONS RESEARCH

from the

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ABSTRACT

As the Army continues to fight in Afghanistan and Iraq, its steady need for Reserve Component Soldiers has impacted the ranks of the Army Reserve. The officer ranks are experiencing critical shortages in the ranks of captain and major. The Army Reserve's goal over the next five years is to not only eliminate the officer shortages, but to also increase the number of officers in its ranks. This thesis applies a combination of projection techniques to historical data for officer strengths, accessions, promotions, and losses to predict what the Army Reserve officer strengths of second lieutenant through lieutenant colonel will be over the next five years barring any administrative actions. The first finding is that second lieutenant strength is not projected to drop below its 2007 total between 2008 and 2012. The second finding is that the maximum values of the projected endstrengths show no gains through 2012. The recommendation is that the Army Reserve reviews all current officer positions. Possible actions are to keep a position as it is, permanently combine certain duties from a group of positions into fewer positions, cut a position, or reassign a position to either another rank or a civilian position.

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LIST OF ABBREVIATIONS AND ACRONYMS

1LT	first lieutenant
2LT	second lieutenant
AC	Active Component
AGR	Active Guard/Reserve
AREAFM	Army Reserve Enlisted Aggregate Flow Model
AT	Annual Training
COL	colonel
CPT	captain
E1	private
E5	sergeant
E9	sergeant major / command sergeant major
G1	command-level personnel section
HRC-STL	Human Resources Command – St. Louis
IMA	Individual Mobilization Augmentee
IRR	Inactive Ready Reserve
LTC	lieutenant colonel
OCAR-HR	Office of the Chief of the Army Reserve – Human Resources
MAJ	major
MRD	mandatory removal date
OCS	Officer Candidate School
RC	Reserve Component
ROTC	Reserve Officer Training Corps
SELRES	Selected Reserve

TAPDB-R	Total Army Personnel Database – Reserve
TDA	Table of Distribution and Allowances
TOE	Table of Organization and Equipment
TPU	Troop Program Unit
USAAC	United States Army Accessions Command
USARC	United States Army Reserve Command

EXECUTIVE SUMMARY

The terrorist attacks that took place on U.S. soil on September 11, 2001, forced the United States military to shift into a new mode of operation. Within just a couple weeks after the attacks, numerous Army Reserve units began activating and preparing to support the immediate domestic need to secure all of the federal landmarks and Army posts that had been, up until that time, completely open to the public. As the Army began fighting wars in Afghanistan and Iraq, the need for Soldiers increased as did the Army's reliance on the Reserve Component (RC).

RC Soldiers soon found themselves caught up in the Army's high operational tempo, and many were activated to serve full time in various capacities both in the U.S. and abroad. The nation began to rely heavily on the Army Reserve over the past five years while at the same time trying to expand the Active Component force. This new set of demands has taken its toll on the Army's recruiting and retention as a whole, and the Army Reserve has begun to experience critical shortages in the ranks of captain and major.

The Army Reserve's goal is to not only fill the officer shortages, but also to increase the number of officers in its ranks. This thesis applies a combination of projection techniques to seven years of historical data of officer strengths to predict what the Army Reserve officer strengths of second lieutenant through lieutenant colonel will be over the next five years barring any administrative actions. This thesis also applies the same projection techniques to five years' worth of historical data with regard to accessions, promotions, and losses to give a more complete picture of possible strength levels. There are two major findings.

The first finding is that second lieutenant strength is not projected to drop below its 2007 total between 2008 and 2012. This means the current practices for managing accessions, promotions, and losses are adequate to keep the officer strength at this paygrade stable over time.

The second finding is that the maximum projected endstrengths showed either minor losses or stayed about the same. This means that with current trends, the best case scenario the Army Reserve can expect from 2008 to 2012 is for the size of its officer corps to stay about about the same.

Under any projection scenario, officer shortages the Army Reserve will continue to exist. Currently, not every position is critical to the Army Reserve mission. A large portion of the authorized positions are essential for the proper training and deployment of the Reserve force, but some are not as essential. The recommendation is that the Army Reserve reviews all of its current officer positions. The recommended action is to identify positions where the duties can either be done by an officer in another duty position; reassigned to a warrant officer, non-commissioned officer, or civilian; or eliminated entirely.

ACKNOWLEDGMENTS

This thesis would not have been possible without the combined efforts of numerous people. First and foremost, I'd like to thank my wife, Meghan, whose love and support made everything possible. MAJ Bob Radtke and LTC Carlos Perez both worked tirelessly to provide data that would make this thesis work and pointed me to others who could help fill in the gaps. The support and direction from COL Frank Willingham and LTC James Morrison were invaluable and helped tremendously. LTC Robert Humphrey, LTC James Wiley, MAJ Tricia Ginther, MAJ Toney Filostrat, MAJ William "Bubba" Lewis, MAJ Jamal Miles, Mr. Dan Swacina, and Mr. Jeff Marmorstein were all also instrumental in getting me headed in the right direction and staying the course. Special thanks to Dr. Sam Buttrey and Dr. Robert Koyak whose experience and patience was reassuring when things looked bleak.

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I. INTRODUCTION

A. BACKGROUND

On September 11, 2001, the United States military began a new mode of operation. Within just a couple weeks after the attack, numerous Army Reserve units began activating and preparing to support the immediate domestic crisis of securing all of the Army posts that had been, up until that time, completely open to the public. As the Army began fighting wars in Afghanistan and Iraq, the need for Soldiers increased as did the reliance on the Reserve Component (RC). RC Soldiers soon found themselves caught up in the Army's high operational tempo, and many of them were activated to serve full-time in various capacities both in the U.S. and abroad.

The RC is made up of many different sub-categories. The main three are the Individual Ready Reserve (IRR), the Retired Reserve, and the Selected Reserve (SELRES).

The IRR is made up of Soldiers who are considered inactive and are not required to participate in Army exercises and activities. These individuals may volunteer for operations and receive active duty pay and benefits for a set time period before going back into the IRR. IRR Soldiers can be involuntarily called to active duty by the Presidential Reserve Call-up Authority, at which point they enter active duty status for the duration of the call-up.

Retired Reserve Soldiers are those under the age of 60 who have already retired, are either awaiting or drawing their retirement pay. Those who are not classified as disabled can be recalled and put on active duty by the Secretary of the Army in a time of national emergency or war.

The largest category, which is the focus of this thesis, is the SELRES. The SELRES is the working force of the Army Reserve, and Soldiers in this group are classified into one of three sub-categories: the Troop Program Units (TPU), Active Guard/Reserve (AGR), or Individual Mobilization Augmentee (IMA).

The first sub-category, TPU, makes up the bulk of the SELRES. Soldiers who are part of the TPU force have civilian occupations and are not on active duty full time. They attend Battle Assembly one weekend per month to hone their individual readiness skills and participate in Annual Training (AT) once per year for a two-week period to practice collective training tasks. These Soldiers are subject to mobilization and deployment. Upon the completion of twenty years of service, these Soldiers receive a letter that announces their eligibility for retirement, but they do not collect their benefits until they reach the age of 60. Once they receive their Twenty-Year Letter, these Soldiers can elect to be placed on the rolls of the Retired Reserve and can stop attending Battle Assemblies and ATs.

AGR Soldiers are full-time active duty Soldiers whose mission is to support the Army Reserve in various capacities. Since TPU Soldiers are only present for one weekend per month and two weeks per year, AGR Soldiers perform all of the tasks necessary to ensure TPU Soldiers are properly supported in the areas of training, administration, and logistics. These Soldiers can be assigned to duty positions in a TPU to help facilitate unit readiness and may accompany a TPU during a deployment. AGR Soldiers receive the same pay, benefits, and retirement as Active Component (AC) Soldiers.

IMA Soldiers are also on active duty, but the duty classification of IMA is not a permanent one. As explained previously, when a TPU is activated and mobilizes, each member of that unit is put on active duty. An IMA Soldier is not part of a mobilizing unit but enters active duty as an individual. These Soldiers can come from the IRR, out of the Retired Reserve, or from a TPU. IMA Soldiers are similar to AGR Soldiers in that they are on active duty filling a support role, but differ in that their term of duty is temporary and they are not on an active duty retirement plan. The length of the service can last anywhere from a few months to a few years and can be modified to meet the Army Reserve's needs. Once the term of service ends, IMA Soldiers typically return to their previous status.

As the U.S. still maintains an all-volunteer force, the level of commitment from each of the volunteers varies. While AGR and IMA Soldiers volunteer for active duty, many in the TPU ranks choose to focus on their civilian careers or schooling. Because of the increased operational need for Soldiers over the past five years, the Army has mobilized many of its TPU Soldiers, some multiple times. Due to the operational tempo of the wars in Iraq and Afghanistan, the Army is experiencing recruiting and retention problems at a time when Soldiers are needed. In a 2008 communication, the U.S. Army Accessions Command (USAAC) echoed the observations of other offices across the Army Reserve: the officer ranks are beginning to see critical shortages. The crux of the problem is a combination of retaining mid-career officers, attracting officers leaving the AC, and being able to recruit enough second lieutenants (2LTs) in order to not only offset the losses but also grow the size of the force.

In 2008, the Office of the Chief of the Army Reserve – Human Resources (OCAR-HR) provided data on the officer strengths shown in Figure 1. Assigned officers are the number of officers who have positions in the Army Reserve at the rank indicated. The number of officers authorized for each rank is the number of officer positions the Army Reserve has available.

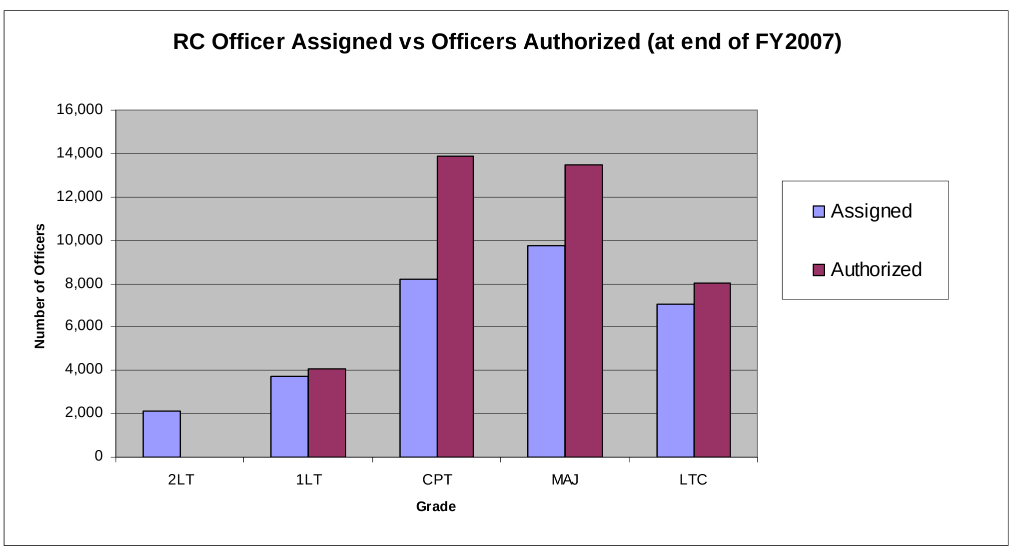

Figure 1. RC Officers Assigned Compared to the Number of RC Officer Authorized

The immediate manning problem in the Army, both AC and RC, is that there are critical shortages in the ranks of captain (CPT) and major (MAJ). The Soldiers at these ranks typically have between three and fifteen years of service. Decisions about continued service are made during these years, and some elect to stay while others do not. To help fill these shortages, the Army has started promoting earlier than what had been the norm. This action requires the Army to bring in more junior officers each year to make up for those lost to the early promotions.

B. THESIS OBJECTIVE

The purpose of this thesis is to project officer strengths in the Army Reserve over the next five years (2008-2012) by taking into account the historical accessions, promotions, and losses over the past five years (2003-2007). These three factors are analyzed for trends to provide an overall picture of what staffing levels will look like, barring any administrative actions such as stop-loss or a change to the promotion rates. As different manpower models have various strengths and weaknesses, several methods are employed to make the projections. Results of this analysis provide a range of projected for each paygrade.

C. MANPOWER MODELS CURRENTLY USED BY THE ARMY

The Army Reserve has a model to support promotion planning that projects officer staffing levels five years into the future. The Army Reserve's Human Resources Command in St. Louis (HRC-STL) maintains a database called the Total Army Personnel Database – Reserve (TAPDB-R) that contains current information on all Soldiers currently serving in the Army Reserve. Analysts in HRC-STL's Analysis, Transformation, and Integration Directorate retrieve information from the system on an assortment of personnel actions and make projections based on that data. Separate forecasts are made for the IMA, TPU, and AGR populations, although provisions are made to combine the forecast into a single SELRES forecast. The end-strength totals each year change by adding the numbers for the gains and subtracting the numbers for the losses to get the next year's total. Gains are comprised of data for "promotion selections into grade" and "transfers into grade." Losses are comprised of data for "promotions selections out of grade," "mandatory removal date (MRD) losses," and "unscheduled losses." Promotions into (or out of) grade are forecast by applying historical promotion rates to the forecasted volume of the future-year promotion zone. Unscheduled losses are forecast based on percentage loss rate by grade determined by examining five years of historical data. Projected MRD numbers are calculated by totaling the number of officers with an MRD shown for a given future year in TAPDB-R. To balance the equation with OCAR-HR's projected manning goals for each year, the total number of transfers into grade is set equal to the difference between the projected goal and the projected total without considering transfers. That number is distributed to each paygrade based on the historical proportion of that grade's gains into the population.

The Army's personnel office, the G1, has a model for projecting officer strengths in the AC seven years into the future broken down by month. The endstrength for a given time is a calculated by starting with the prior total, subtracting losses and promotions out of a paygrade and adding gains and promotions into a paygrade. To project losses, the Army G1 uses a model called Holt-Winters smoothing, which accounts for seasonal variations in the data. Typically, about four years of inputs are put into the model. The number of soldiers scheduled to retire during the projection period are considered and may be used as a basis to augment a projection. Gains for a given year are projected using the previous year's gains. Almost all gains are by commissioning. Few transfers come from other components of the Army and other branches of services, so they are not considered in the model. Promotion rates are set by the Promotions Branch, and are used as inputs into the projection model. The goals for future years are set to maintain the staffing levels at each grade above 2LT. All of the inputs used in this thesis are the same as those in the function used by Army G1. All data for this thesis are not broken down by month, so exploring the seasonal effects using Holt-Winters smoothing is not done.

D. RELATED WORK

A number of previous works on military manpower exist. Ginther (2006) developed the Army Reserve Enlisted Aggregate Flow Model (AREAFM). The

AREAFM used a Markov chain to predict staffing levels for Army Reserve enlisted ranks. A Markov chain uses a transition matrix to outline what percentage of a population moves from one given state to another during a set time step. For example, a Soldier in the AREAFM that is classified as a sergeant (E5) at the beginning of the year can either end the year either as an E5, move to another rank (E1 through E9), or move to Attrition. Since all possible states are covered in the matrix, the transitional probabilities in any state in a Markov chain add up to 1. The rates derived for each state in the AREAFM were an average of the previous three years' worth of data for accessions, promotions, demotions, and losses. Ginther's methodology was to use those rates in a Markov chain to predict the following year's numbers at each paygrade. The categories Ginther used in her model provide a useful basis for the officer strength projection model assembled in this thesis.

Gibson (2007) explored the effects that changing promotion and retention policies might have on the overall end strength of MAJs in the AC. Using a Markov chain model similar to Ginther (2006), Gibson also found that accelerating the promotion time to major by one year would minimize the shortfalls in that paygrade without adversely affecting the end strength of CPTs. Gibson found that accelerating promotion from CPT to MAJ while simultaneously slowing the promotion rate from MAJ to lieutenant colonel (LTC) by one year did not produce a significant increase in the MAJ ranks compared to the policy of increased promotion time to MAJ alone. In addition, Gibson found that slowing the attrition rate of the CPT ranks by 50 percent would maximize the total number of MAJs. Gibson's conclusions are taken into account in interpreting the data outputs used in this thesis.

Feiring (2006) compared several projection models to select one that appeared to fit Marine Corps enlisted data. He looked at simple exponential smoothing, Holt's linear exponential smoothing, Holt-Winters seasonal exponential smoothing, moving averages, multiplicative decomposition forecasting, and Box-Jenkins forecasting. All of the models were evaluated by comparing the absolute percentage error, the sum of squared errors, and mean absolute error. Three of the models examined in Feiring's thesis are also explored in this thesis: moving average, exponential smoothing, and Holt smoothing.

Phillips (2006) created a policy template for manpower projection that outlines a workforce planning strategy. Analysis of trends in employment staffing levels and turnover are used to assist managers in making forecasts. Additionally, an "organization's strategic plan and allied business plan provide guidance as to the number and type of employees that the organization needs during the planning period" (Phillips, 2006). Based on Phillips' recommendation, a study of the force structure could be used to determine the required size of the Army Reserve's future force.

Dolfini-Reed, et al. (2005) conducted a study on the trends of enlisted losses in all services and components since 2001. The study does not provide a projection model, but recommends a modeling strategy using a combination of multinomial logit regression and Cox regression. The study found Soldiers' duty statuses and the lengths of mobilization or deployment had bearing on attrition rates. Those who activated and deployed had lower attrition rates than those who were never activated and those who activated but did not deploy (Dolfini-Reed, et al., 2005). Dolfini-Reed, Parcell and Horne (2005) shifted their focus to the study RC officer attrition. The findings when exploring officer attrition rates were similar to those of the enlisted study. The factors of individual activation and deployment history were not available and therefore are not used as predictors in this thesis; however, as Soldiers deactivate in the near future and others re-activate and deploy, there may be an effect on future losses that this thesis' projection model could not account for.

Corbett (1995) presented a model for optimizing officer accessions in the AC. The model used queuing theory to show the effects of branch detailing, which is the practice of assigning 2LTs into one branch while planning to transfer them to another branch at a set time. The goal was to maximize "the Army's ability to meet branch specific officer strength requirements, subject to the goals and objectives of [the Army's offices concerned with manpower]" (Corbett, 1995). This study looked at the impacts of accessions into each branch and the management of strength levels thereafter to ensure a fair distribution of officers. The output was an optimization of the distribution of incoming 2LTs that allowed for the best staffing levels in the future. Exploring the staffing levels by branch may assist in diagnosing assignment issues such as overages in some branches and shortages in others.

Gass et al. (1988) developed a system of linear programming models that showed projections 20 years into the future based on existing policies. Inputs to the models include paygrades, skill identifiers, and time horizon. The models "simulate the interaction of gains, losses, promotions, and reclassifications" (Gass, et al. 1988). The system's outputs showed policy changes that were required to reach the desired goals.

II. RESEARCH METHODOLOGY

A. DATA COLLECTION AND PROCESSING

The data analyzed in this thesis came from a number of offices in the Army Reserve. These offices and the data they provided are identified in the following sections. In some cases, the data generated by each office did not always come from the same source; in others, data came from the same source as in another office but was collected and stored with different goals in mind. As such, some offices provided different numbers that were intending to describe the same information. After careful scrutiny of what information each data set contained, final numbers were selected for use and others set aside. This chapter describes the process by which the selected data was collected, processed, and applied.

1. Overall Annual Endstrength

HRC-STL's Analysis, Transformation, and Integration Directorate provided the TAPDB-R data for the end of FY07. While this information assists greatly in validating current-year numbers, TAPDB-R doesn't provide complete historical information. Since TAPDB-R only provides real-time data, attempting to retrieve historical data is not directly possible. The Analysis, Transformation, and Integration Directorate does not carry all of the historical data needed for this thesis, so data were requested and gathered from other offices across the Army Reserve.

OCAR-HR has officer strength data for each fiscal year going back to 2001. The data generated by OCAR-HR is used for report generation and analysis by other offices, such as USAAC. The numbers OCAR-HR reported are the overall endstrengths by paygrade per year and are shown in Table 1. These numbers were used as the annual totals for each of the paygrades. The lines in Figure 2 show a generally linear historic trend for each paygrade, and each rank seems to be separated from others by about 2000 officers.

Year	2LT	1LT	CPT	MAJ	LTC	Total
2001	2099	4703	10202	11502	7490	35996
2002	2124	4151	9946	11843	7401	35465
2003	2069	4292	9822	11790	7188	35161
2004	2083	4169	8879	11381	6988	33500
2005	2248	4204	7986	10577	6936	31951
2006	2308	3877	8041	10141	6962	31329
2007	2107	3707	8196	9722	7051	30783

Table 1. Annual Overall Endstrength by Paygrade (2001-2007)

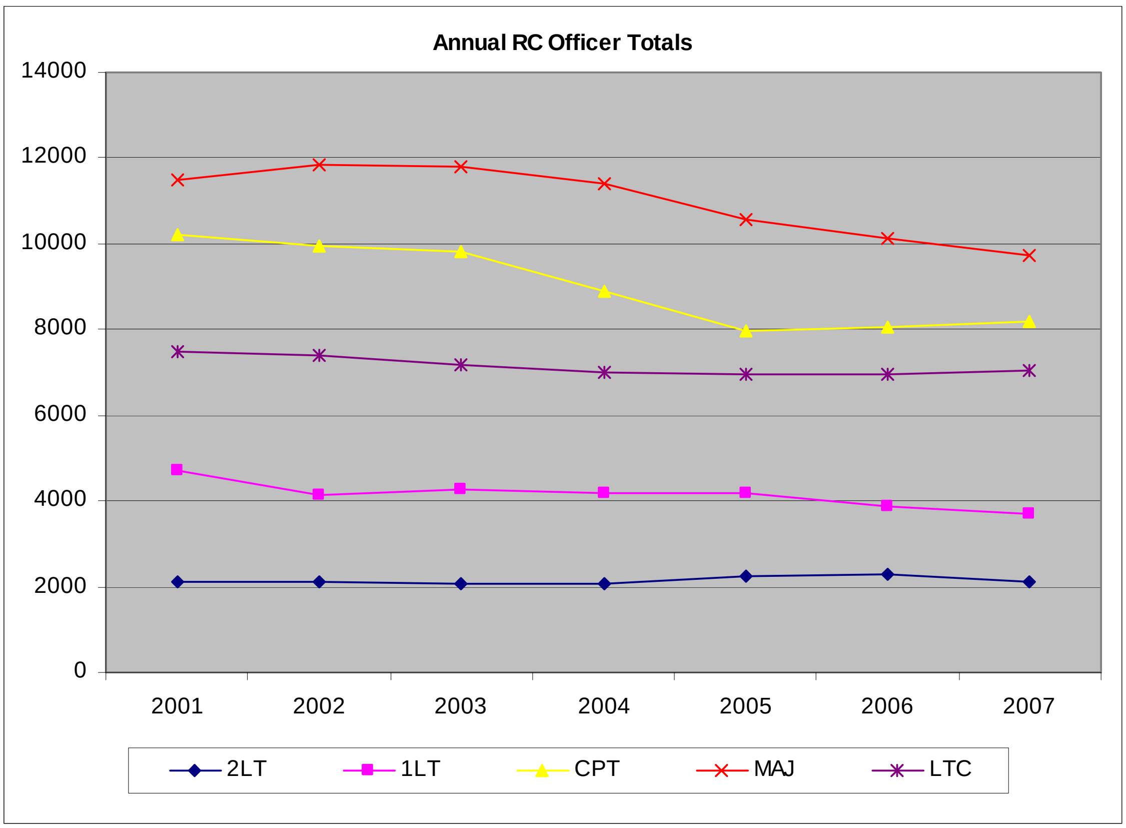

Figure 2. Annual Overall Endstrength by Paygrade

2. Accounting for Accessions

Data on the historic number of officers coming into the SELRES for the past five years (accessions) come from a variety of sources: the Reserve Officer Training Corps (ROTC), Officer Candidate School (OCS), Direct Commission, and transfers from the AC, the Army National Guard, and other branches of service.

ROTC offers commissions into both the AC and the RC to its graduates. Although the Army Reserve is not authorized any 2LTs, according to a 2008 communication with USAAC, there is a standing agreement that the RC will receive a set number of 2LTs from ROTC each year. According to USAAC, in order to help bolster the number of 2LTs in the Active Component, an increasing practice over the past few years has been to send more 2LTs from ROTC to the AC instead of the RC. Because of this, the number of 2LTs coming into the RC out of ROTC programs has decreased.

OCS commissions are offered to enlisted Soldiers or to warrant officers who want to become commissioned officers. There are a few prerequisites that make this option a challenge, the most notable being 60 credit hours of college already completed with a requirement to finish a four-year degree before being promoted to CPT. A serious drawback to this commissioning source is that it takes Soldiers out of the enlisted or warrant officer ranks, where there are also personnel shortages, and puts them into the officer ranks; the net gain to the Army in terms of overall personnel end strength is zero. The Army Reserve has a mission to send a set number of Soldiers through OCS each year, and these Soldiers stay in the Army Reserve upon graduating.

Direct Commissions are given to college graduates who want to become officers. These people may be either civilians or Soldiers in the enlisted or warrant officer ranks. Although historically a majority of these commissions have been given to professionals in medicine, law, or the clergy, they can be issued to someone for any branch of service. A feature of Direct Commissioning is that not every commission is to the rank of 2LT. On occasion, it is possible for someone to receive a Direct Commission to a higher rank. For example, if someone has years of experience and a high degree of technical expertise in a field such as dentistry, the Army Reserve may grant a rank, such as MAJ, that is more commensurate with that person's experience level. The Army Reserve has begun to rely on this commissioning source more heavily as a way to maintain officer staffing levels.

Transfers from the AC, Army National Guard, and other services tend to provide experienced officers to the Army Reserve. Many officers owe a total of eight years to the Army upon commissioning. This initial term of service may be split between the AC and the RC. Some officers leave the AC to serve out the remainder of their time in the RC ranks. Others may have completed their term of service but want to continue as part-time Soldiers. These individuals are important because they help to reduce some of the captain and major shortages that are not filled through the Army Reserve ranks. Transfers from other sources, such as the Army National Guard and the other branches of service, tend to come in smaller numbers.

Soldiers enter the Army Reserve from a number of sources and may enter at virtually any rank. USAAC sees all transitions from the AC and also all ROTC commissions, but it is not made aware of accessions that occur from sources such as direct appointments or inter-service transfers. Detailed accessions data is maintained by the U.S. Army Reserve Command (USARC), located at Fort McPherson, GA.

The USARC's personnel section, the G1, extracts accessions data for all ranks in the SELRES from TAPDB-R and tracks it in a spreadsheet that is updated monthly. The numbers shown in Appendix A are annual roll-ups of the monthly data broken down by rank.

3. Accounting for Promotions

Starting with CPT, officers are promoted through a selection board process. The results of these boards are published and archived in several places. A database of the promotion numbers for CPT through colonel (COL) from 2003 to 2006 was maintained by the Analysis, Transformation, and Integration Directorate at HRC-STL. Those numbers were used in this thesis and are shown in Appendix B.

Data on 2007 promotions for all ranks were taken directly from the TAPDB-R database provided by the Analysis, Transformation, and Integration Directorate at HRC-STL. As TAPDB-R only carries data on Soldiers currently serving, the assumption made concerning the 2007 data is that everyone who was promoted in 2007 was still serving at the end of the fiscal year when the data was captured.

Promotions to first lieutenant (1LT) are not based on board selections as are other ranks. The rank of 1LT is achieved after a set time in grade at 2LT and can be delayed for any number of reasons. As a result, promotions numbers to 1LT must be calculated. The calculations and final numbers used in this thesis for promotions to 1LT for 2003 to 2006 are shown in Section B.

4. Accounting for Losses

The Army Reserve has a number of ways by which a Soldier can exit service. The first is when the Soldier's service commitment expires and that individual no longer wants to be a member of the Army Reserve. The second is retirement, which can be awarded either for time served or for medical reasons. Other reasons for loss include but are not limited to inter-service transfers to the AC, the National Guard, or some other branch of service; punitive and non-punitive administrative separations; and death.

The USARC G1 also carries detailed loss data. Like accessions data, the G1 extracts the information from TAPDB-R to maintain an in-house spreadsheet on the losses in the Army Reserve. Regardless of reason, all losses are captured. The data provided by the USARC G1 are used for loss data in this thesis and is shown in Appendix C.

The next section discusses the methods by which the data are analyzed and how the projections are modeled.

B. MODELING METHODOLOGY

1. The Personnel Flow Function

The changes in staffing levels that occur in each paygrade each year are due to a set of personnel actions. Actions such as accessions and promotions into a rank add numbers to a paygrade, while actions such as losses and promotions out of a rank subtract numbers from a paygrade. The relationship that captures the personnel actions behind the year-to-year changes is shown in Figure 3. A notable difference between the variables in this model and the states used in the AREAFM Markov chain is that there are no demotions for officers in the paygrades being discussed.

Last Year's Endstrength at Grade
+ This Year's Accessions Into Grade
- This Year's Promotions Out of Grade
+ This Year's Promotions Into Grade
- This Year's Losses From Grade

This Year's Endstrength at Grade

Figure 4. The Personnel Flow Function

The Personnel Flow Function is used to solve for the unknown number of promotions to 1LT from 2003-2006. Promotions data for all board selections were provided by the Analysis, Transformation, and Integration Directorate at HRC-STL. Promotions from 2LT to 1LT are different from others in that there is no centralized board process and no statistics are kept on promotions to 1LT. Rearranging the terms of the Personnel Flow Function, we derive the function in Figure 4. With the new version of the function, we can solve for "This Year's Promotions Into Grade" for 1LT. The assumption is that the numbers in the Personnel Flow Function add up to the overall annual totals provided by OCAR-HR. The complete data set for promotions is shown in Appendix B.

This Year's Endstrength at Grade
- Last Year's Endstrength at Grade
- This Year's Accessions Into Grade
+ This Year's Promotions Out of Grade
+ This Year's Losses From Grade
This Year's Promotions Into Grade

Figure 5. Revision of the Personnel Flow Function. This form of the equation allows us to calculate promotions into a paygrade for a given year.

Each of the personnel actions listed in Figure 3 has corresponding historical data discussed in previous sections and is shown in tables in the appendices. Data from those sections are substituted into the Personnel Flow Function to calculate overall endstrength. These data are reported in Appendix E.

The differences between the section totals and the reported overall officer strengths will be discussed in the Results section.

2. The Projection Models

A number of considerations must be taken into account when selecting a forecasting method. First, one must find a model that adequately accounts for historical data. If there is a trend of upward or downward movement in the data, the projection should be in line with that trend. Next, the projected numbers must be feasible. Even though a model fits the given data, it might not produce a projection that is realistic or feasible. In the case of forecasting numbers of personnel, negative numbers are not feasible. Finally, outliers in the data must be identified and controlled. There may be many reasons that a data point does not follow the pattern of the others in the data set, so an analyst must carefully examine each outlier and determine how to best model the overall behavior of the function being considered. A model must not be overly sensitive to a single outlier. In order to get a good variety of possible projections, five models are analyzed, and their outputs will are compared.

The method of averaging the past three years' worth of data to give a prediction seems to work best with a stable system where there is not much fluctuation. The use of averaging helps to smooth out possible outliers and keeps the data within the highest and lowest observed values (Chatfield, 2004). The use of a three-year moving average is one model considered in this thesis.

Since some of the data used in this thesis shows both upward and downward trends, looking at a moving average by itself may not be the best method of prediction. Different types of regression models can also yield meaningful predictions. Linear regressions are able to capture short-term trends. A linear regression model takes the form $y = a + bx$ (Bowerman, O'Connell, and Koehler, 2005). The projection (or dependent variable y) is equal to the intercept (a) plus the slope (b) times the independent variable (x). Linear regression is the second model explored in this thesis.

The use of a transformation of the data by taking the natural logarithm (ln) of the dependent and independent variables and performing a regression also allows for upward and downward trends. When using this technique, projections based on an upward trend will form a concave curve while projections based on a downward trend will form a convex curve. Projections are never negative because Soldier counts are positive numbers. The form for this transformation is $y^* = \ln(y)$ where y^* is the new value considered along with other transformed points in a linear regression (Bowerman, O'Connell, and Koehler, 2005). Once the linear regression on the values of y^* is complete, the resulting transformation back to the original units is $y = Ax^b$. The logarithmic model explored in this thesis is referred to as the Four-Year Log model as it takes into account the past four years' worth of data and applies the transformation described above.

Exponential smoothing is a method of comparing the previous actual value with the previous projected value, weighting them, and coming up with a prediction for the next value. It takes the form $x_{t+1} = \alpha x_t + (1 - \alpha)\, x'_t$ (Bowerman, O'Connell, and Koehler, 2005). When applied to historical data, the weights that yield the best fit can be calculated using software to change α and minimize the amount projections deviate from the actual data. Once the best α is selected, the projections that follow the final calculated projection are exactly the same. This does not allow for upward or downward trends to continue into the future, but coupled with the other models it gives a more complete picture of the possibilities. Exponential smoothing is the fourth model used in this thesis.

The final model, Holt smoothing, is similar to exponential smoothing but uses terms called the *trend* and the *level*. The trend is the "long-term change in the mean level" (Chatfield, 2004). The level is another term for the mean (Bowerman, O'Connell, and Koehler, 2005). It takes six steps to complete this model, and for a projection to be calculated the trend and the level must be calculated first. The formulas presented in the following list are taken from Chatfield (2004) with minor differences in notation.

(1) Set the initial values for the trend and the level. The initial value of the trend (T) is $T_1 = x_2 - x_1$, where x_t is the observed value at timestep t. The initial value for the level (L) is $L_1 = x_1$.

(2) Calculate the initial prediction (x') using the formula $x' = L_1 + T_1$. This form is used for all projections where there is a known value x for that timestep.

(3) Calculate the level by using the equation $L_{t+1} = \alpha x_t + (1 - \alpha)(L_t + T_t)$.

(4) Calculated the trend using the formula $\beta(L_{t+1} - L_t) + (1 - \beta)T_t$. With the level and trend computed, the next projection can be made using the equation in step two.

(5) Calculate the goodness of fit by minimizing the function $\Sigma^t_{i\text{-}1} (x_i - x'_i)^2$ where i is the first timestep with a projection and t is the final timestep. The outputs are subject to both α and β being between 0 and 1.

(6) Make continued projections using the equation $x'_{t+n} = L_{t+1} + n(T_{t+1})$ where n is the number of timesteps being projected beyond the last observed value. Once the final projection from given data is computed, the trend is multiplied

by the number of timesteps being projected into the future (n), and that value is added to the last observed value. The continued projections form a line with intercept L_{t+1}, slope n, and independent variable T_{t+1}.

Figures 5 and 6 give a simple example using data sets where the five forecasting models yield substantially different answers. In Figure 5, there is an upward trend in the data and we look at the following year's prediction. In Figure 6, the same data are examined, and the next five predictions are examined.

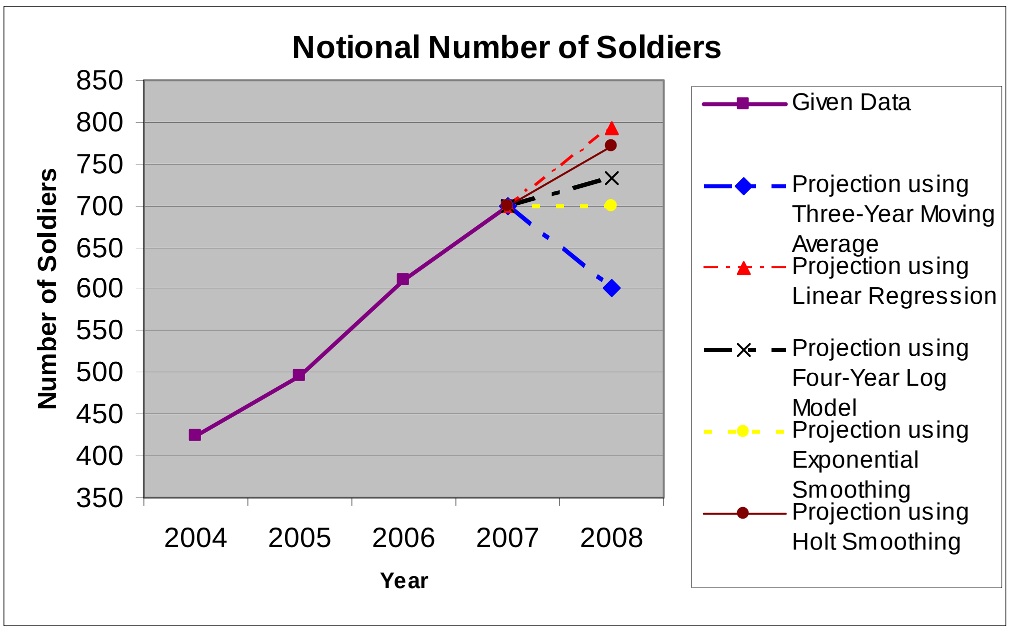

Figure 6. Example of One-Year Projection of Upward Trend (Data from 2004-2007)

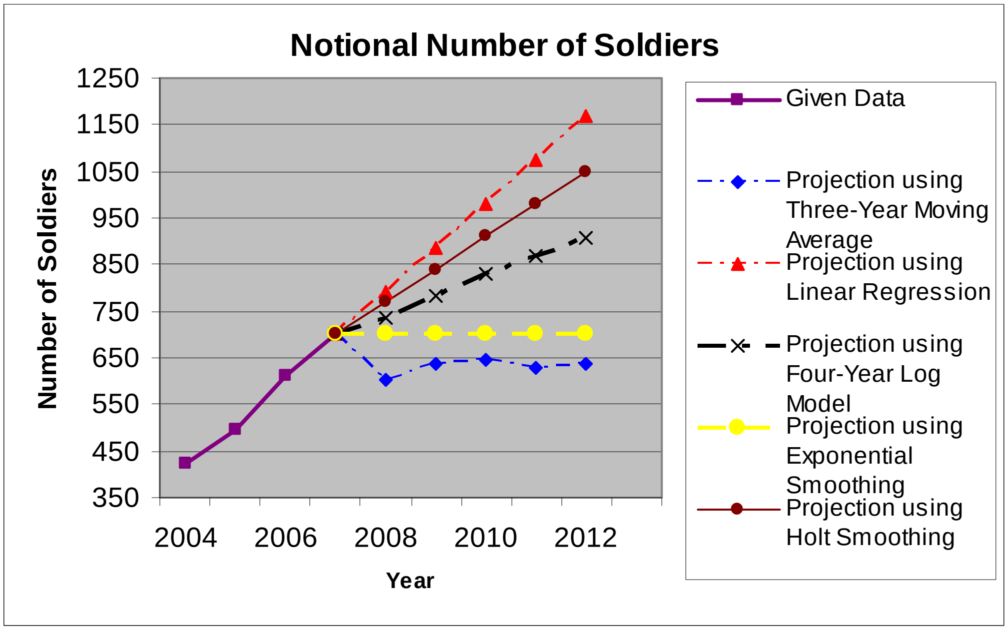

Figure 7. Example of Five-Year Projection of Upward Trend (Data from 2004-2007)

In each figure, there is clearly a difference in projected numbers. Linear regression or Holt smoothing appear to be the models that fit the data the best. With real data sets, it is sometimes difficult to determine if a regression is more appropriate or if a method such as using the average makes the most sense. This thesis deals with manpower levels in a fairly stable system. The three-year moving average projects a number within the range of observed values, so numbers generated with this method are always feasible. The linear regression accounts for the upward trend in the data, but it can begin to project infeasible numbers faster than other models. The Four-Year Log model also accounts for the upward trend in the data and decreases in slope over time. Exponential smoothing uses weights on past projected values and past actual values to derive the next projection, then allows the final calculated projection to stand for future projections. Holt smoothing weights trends and levels to derive projections, then applies a linear model to make further projection. In this thesis, all five models are applied to the baseline annual endstrengths given as well as the calculated total from adding the component pieces of the equation shown in Figure 3 (accessions, promotions, and losses).

Additionally, each of the methods is applied to each of the components before combining them into the Personnel Flow Function. This process will yield 15 sets of projections. The predictions provide a range of predictions for each paygrade and for overall officer strength. The results are compared and analyzed in the next chapter.

III. RESULTS AND DISCUSSION

A. VALIDATING THE PERSONNEL FLOW FUNCTION

Theoretically, the Personnel Flow Function should accurately show the changes in the totals from year to year. However, there are notable differences between the output of the Personnel Flow Function and the original baseline data (see Table 3). The overall calculated numbers, shown in Table 2, do not match the original baseline data shown in Table 1. Table 3 shows the total differences between the reported and calculated overall values. The numbers in this table are calculated by taking the original given overall officer strength levels in Table 1 and subtracting the derived totals from Table 2. A positive number shows that the original data has the higher value. A negative number means the calculated total has the higher number.

Year	2LT	1LT	CPT	MAJ	LTC	Total
2003	2433	4292	9075	11505	7584	34889
2004	2599	4169	8134	10493	7359	32754
2005	2945	4204	6930	9622	7157	30858
2006	3365	3877	6675	9174	7098	30189
2007	2806	3758	7014	9197	6690	29465

Table 2. Annual Overall Endstrength by Paygrade from Section Data (2003-2007)

Year	2LT	1LT	CPT	MAJ	LTC
2003	-364	0	747	285	-396
2004	-516	0	745	888	-371
2005	-697	0	1056	955	-221
2006	-1057	0	1366	967	-136
2007	-699	-51	1182	525	361

Table 3. Differences between Reported Overall Endstrength Totals and Totals Calculated using the Personnel Flow Function

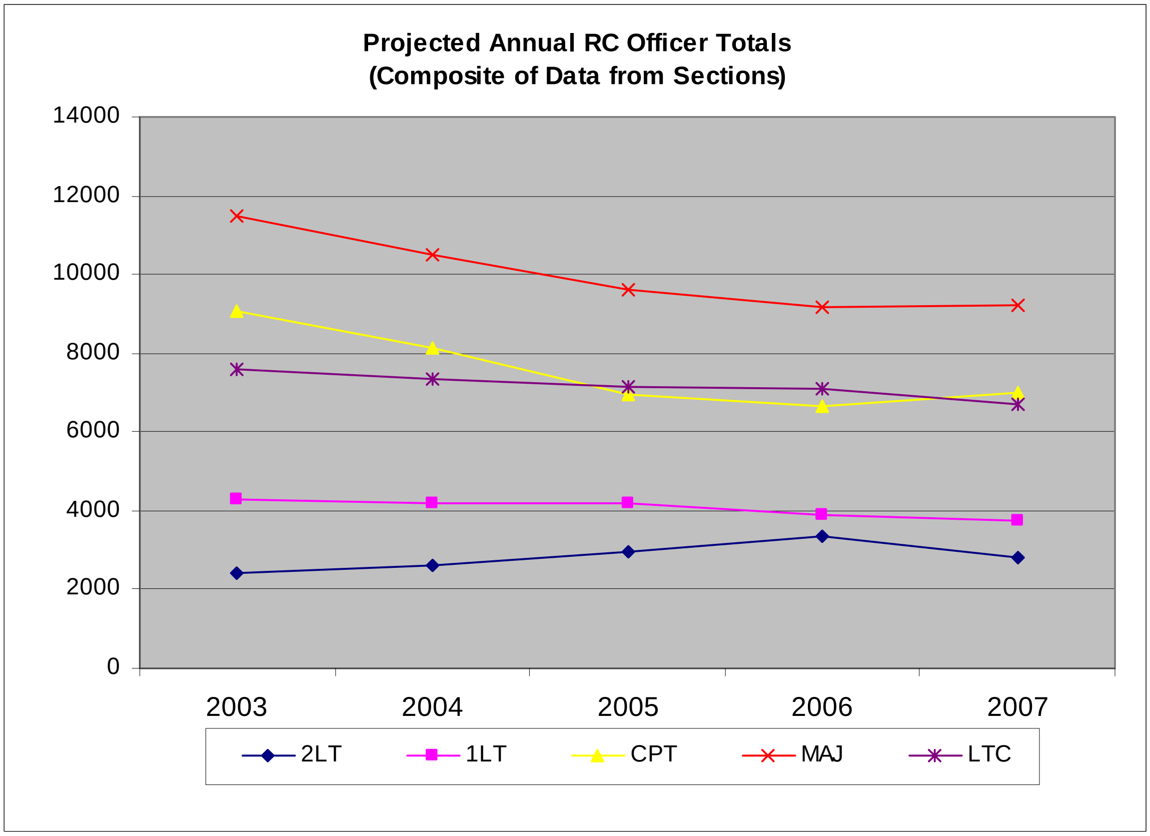

Figure 8. Annual Overall Endstrength by Paygrade (Composite of Data from Sections)

The reason the difference in the data for 1LT is zero for 2003-2006 is that the Personnel Flow Function was modified and used to figure out the number of promotions for those years. Had the assumed relationships between the variables in the Personnel Flow function held, all of the differences would have been 0.

Variations in the data may have occurred for a number of different reasons. The first is that administrative errors may have occurred when entering data into TAPDB-R. This might account for a small portion of the differences. The larger portion of differences in the data may be due to the differences in the data collection methods of the various offices that provided the data. All of the data for accessions, promotions, and losses was taken from TAPDB-R, but the way the data was extracted depended on how the person collecting it filtered the data. There is no indication of which data set contains errors.

Because of the differences in the given data and calculated totals for overall strengths, each of the five models is applied not only to the given data for overall strength totals, but also to the combined totals from the sections. Additionally, the models are applied to the individual sections and then the results combined using the Personnel Flow Function. A model that fits one data set best may not be the best fit for another, so analysis is performed on each data set independently.

B. COMPARISON OF MODELS FOR OVERALL ENDSTRENGTH

Each of the models is applied to the given overall endstrength numbers. The results are shown in Appendix D. The models are in agreement in projecting a general decline at each paygrade. With two exceptions where the projected CPT population dropped below the projected LTC population, the rank ordering of the paygrade populations does not change.

The least squared error method is used to compare the models' projections for 2005-2007 against the given totals for all ranks. The linear regression model is recalculated using the years 2001-2004. The model that fits this data set the best is Holt smoothing. The same method is used to compare only the 2007 projections. The linear regression model is recalculated to include the years 2001-2006. Again, Holt smoothing shows the best fit. Results are shown in Table 4 and compared with the actual reported totals in Figure 8. In Figure 8, the actual reported totals are those with dotted lines.

	Sum of Squared Differences	
Model	2005-2007	2007 only
Three-Year Moving Average	6,972,266	1,127,852
Linear Regression	6,886,016	955,412
Four-Year Log Model	3,504,792	567,407
Exponential Smoothing	2,053,215	251,570
Holt Smoothing	1,167,034	206,800

Table 4. Comparison of Sums of Squared Differences

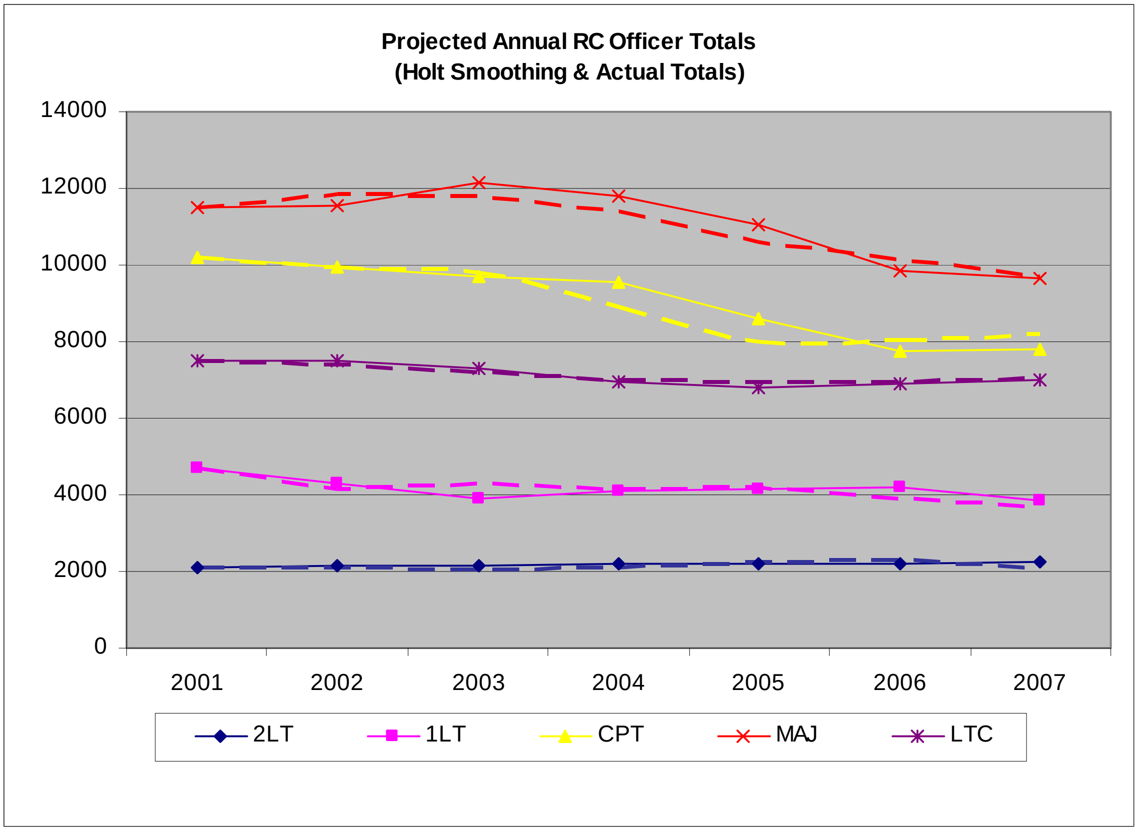

Figure 9. Projected Overall Endstrengths (Holt Smoothing and Actual Totals). Solid lines represent the outputs of the Hold smoothing model. Dotted lines indicate the reported totals for each year.

Comparing the results of each of the models and selecting the maximum projected values from each year and paygrade beginning in 2008 gives a consolidated table of values (found in Appendix D). The same process is followed using the minimum values from each model (also found in Appendix D). Figure 35 in Appendix D shows the span of data for the different paygrades. For 2LT, the maximum and minimum values are very close each year. This means that when applying five different models and comparing the results, the highest and lowest values between all of the models were nearly in agreement. Though the trends appear to be the same, they differ by about 150 Soldiers in 2008 and about 200 Soldiers in 2012.

C. COMPARISON OF MODELS FROM SECTION DATA

1. Combining Data before Applying the Models

As noted previously, the given overall endstrength data does not match up with the combined section data calculated using the Personnel Flow Function. The five models are applied using the numbers calculated by the Personnel Flow Function. The results are shown in Appendix E.

The least squared error method is used to compare the models' projections for 2007 against the given totals for all ranks. The linear regression model is recalculated to include the years 2003-2006. The model that fits this data set the best is exponential smoothing (shown in Table 5). The calculated overall totals are shown in Figure 9 (using dotted lines) next to the exponential smoothing totals.

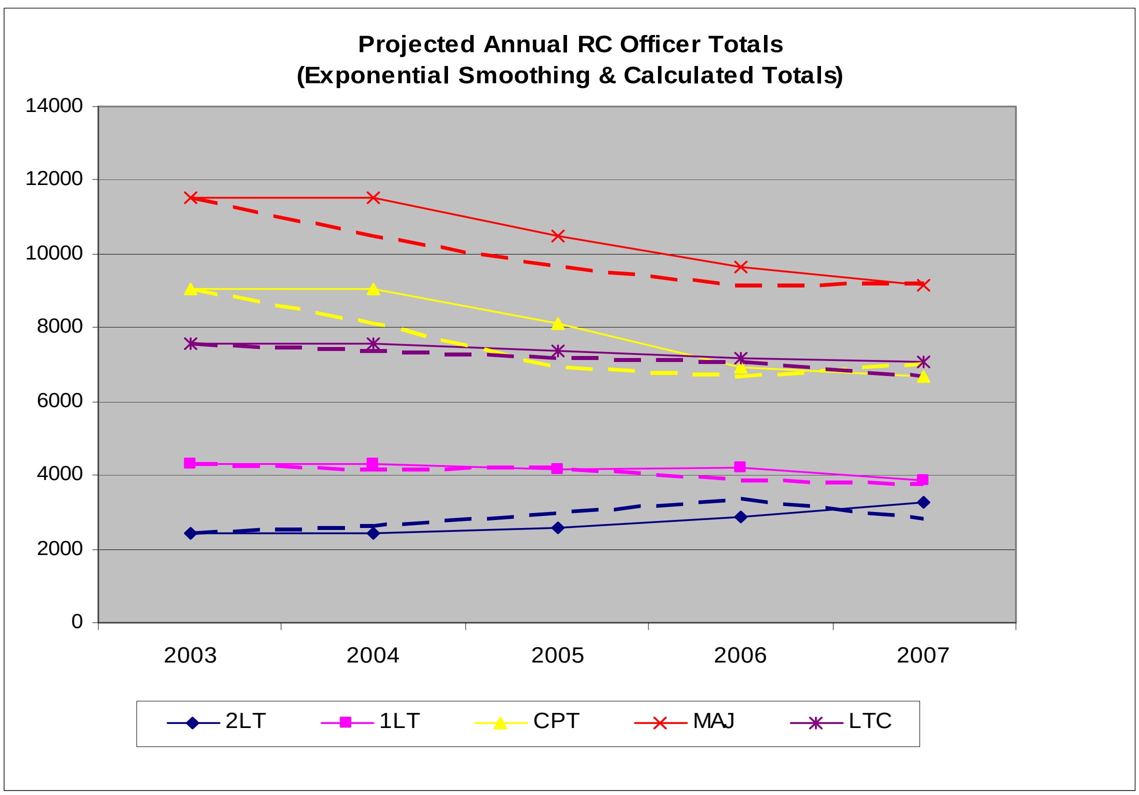

Figure 10. Projected Overall Endstrengths (Exponential Smoothing and Calculated Totals). Solid lines represent the outputs of the exponential smoothing model. Dotted lines indicate the reported totals for each year.

	Sum of Squared Differences
Model	2007 only
Three-Year Moving Average	771,845
Linear Regression	3,630,273
Four-Year Log Model	1,040,164
Exponential Smoothing	510,341
Holt Smoothing	1,730,309

Table 5. Comparison of Sums of Squared Differences

2. Applying the Models before Combining the Data

The five models are applied to each of the data sets for accessions, promotions, and losses. The Personnel Strength Function was then used to combine section data into overall endstrength by paygrade by year for each model (Appendix F). Many of the results produced when combining the section data appear to show additive effects. What might be a modest increase or decrease in the projected overall strengths discussed in the previous sections sometimes bears out as a large increase or decrease when all of the section data are combined. For example, projections for CPT staffing levels using Holt smoothing differ greatly from the results of the previous methods. The projected values from the given overall endstrengths data range from 7,940 CPTs in 2008 to 6,916 CPTs in 2012. The projected values from the calculated overall endstrengths data range from 6,603 CPTs in 2008 to 4,960 CPTs in 2012. While these results are not the same, they do show a decline in the projected number of CPTs. The values projected when applying the models then calculating the totals range from 6,569 CPTs in 2008 to 15,955 CPTs in 2012. While projected accessions and losses of CPTs over this time period are stable, CPT promotions are projected to increase while MAJ promotions are projected to decrease. This overall increase in CPT endstrength is compounded each year, creating a large 2012 projection.

A comparison of the models yields the sums of squares shown in Table 6. Based on the sum of squared differences results, the best composite model is a combination of Holt smoothing applied to accessions and promotions, and exponential smoothing applied to losses. The calculated projected totals for this combination are shown next to the calculated overall totals (dotted lines) in Figure 10.

Model	Accessions	Promotions	Losses
Three-Year Moving Average	304,156	1,208,629	178,906
Linear Regression	1,333,450	870,980	402,139
Four-Year Log Model	885,548	750,928	247,037
Exponential Smoothing	209,729	857,672	97,794
Holt Smoothing	123,944	527,077	262,574

Table 6. Comparison of Sums of Squared Differences

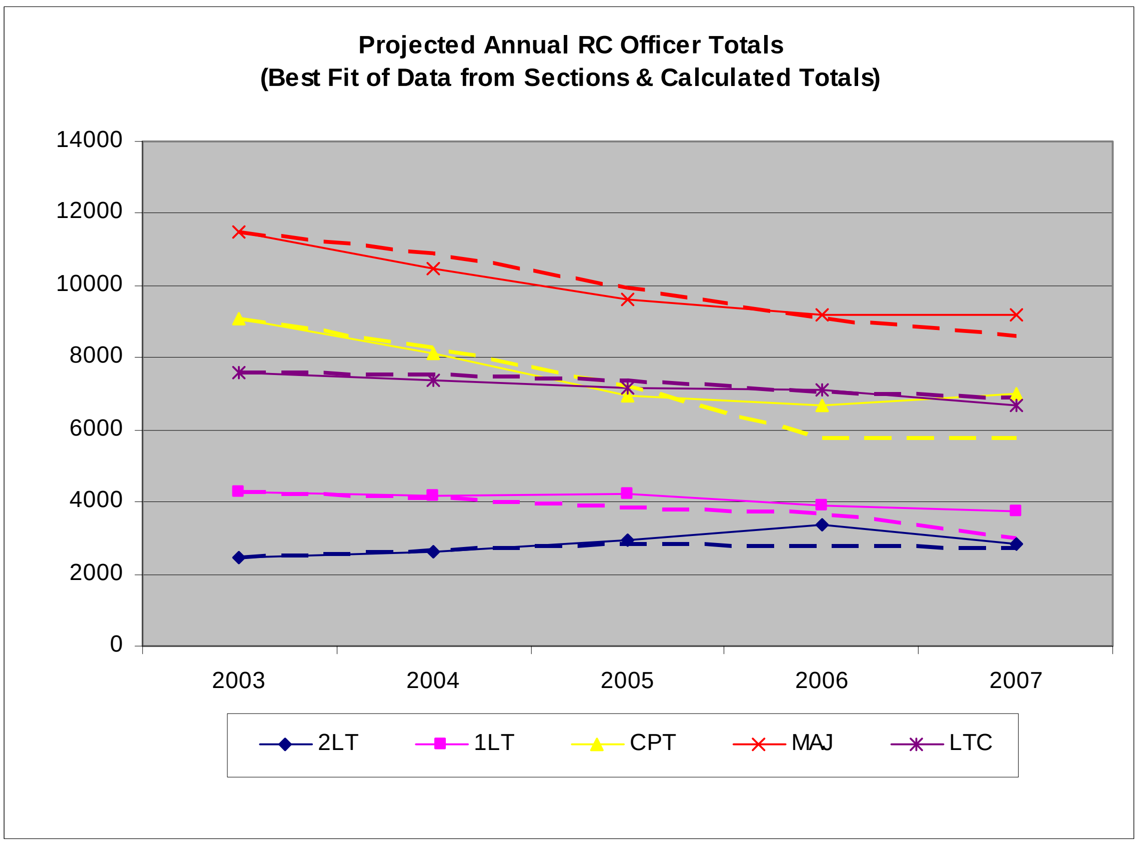

Figure 11. Projected Overall Endstrengths (Best Fit Data and Calculated Totals). Solid lines represent the outputs of the models of best fit. Dotted lines indicate the reported totals for each year.

The short-term projection fits the data well. Figure 47 in Appendix E shows the long-term projections. The projected values in 2012 for CPT and MAJ approximately doubles those paygrades in size from their 2007 totals while the minimum projected values for the 2LT and 1LT ranks dip well into the negatives. Though the negative outputs at 2LT and 1LT are not feasible, and the CPT and MAJ outputs are not likely, they may indicate a scenario where CPT and MAJ ranks are filled, but come at great expense to the lower paygrades. This may be an effect caused by increased promotion rates.

IV. CONCLUSIONS AND RECOMMENDATIONS

The Personnel Flow Function is an all-inclusive mathematical statement about the year-to-year changes to endstrength. With minor administrative errors, there should be little or no difference between the reported totals and the calculated ones. The data for accessions, promotions, and losses for each year are combined using the Personnel Flow Function to derive the overall endstrengths. With the data provided, the outputs of the function are not the same as the reported totals. Analysis of five different projection models finds that Holt smoothing fits the reported totals best and exponential smoothing fits the calculated totals best. When applying models to accessions, promotions, and losses before combining them with the Personnel Flow Function, Holt smoothing has the best fit with accessions and promotions data, while exponential smoothing has the best fit with loss data. The source of the discrepancies in the data is not known, so recommending a model to employ is not possible at this time. Since accessions, promotions, and losses are important factors for future manpower planning, the Army Reserve should invest time to find and fix the discrepancies in the data.

Looking at the projections for overall reported endstrength and overall calaculated endstrength, 2LT staffing is not projected to drop below its 2007 total between 2008 and 2012. All five models project either no change or increases when applied to both the given and calculated totals for overall endstrength. This means the current practices for managing accessions, promotions, and losses may be adequate to keep the officer strength at this paygrade stable over time.

Overall endstrengths by paygrade are examined using five different projection models. There are three models that fit the data better than the others depending on how the data are analyzed. The total projected endstrength using Holt smoothing on the given overall endstrength data shows a loss of about 4000 officers. Applying exponential smoothing to the calculated overall endstrength shows the total endstrength to be about the same as the 2007 total. When applied to accessions, promotions, and losses then combined, the models with the best fit project a loss of about 2500 officers. With the current officer shortages and the apparent downward trends in the endstrengths, these projections fall short of fulfilling the officer levels desired by the Army Reserve.

The current practices for projecting future staffing levels use different models for projection in areas such as accession, promotions, and losses. These results are combined to provide the overall projection. When combining the areas of accessions, promotions, and losses, the results do not project positive numbers of Soldiers by 2012. The number of 2LTs and 1LTs are negative, and CPTs and MAJs show large gains. Gibson (2007) studied the effects of different promotion rates and found a balance for the AC officer ranks. A similar study of the Army Reserve's promotion rates could help to determine a promotion policy to optimize staffing levels.

It appears that the best case scenario is for the Army Reserve to maintain approximately the same numbers at each paygrade as were reported in 2007. The Army Reserve is already operating below its authorized endstrength and seeks to increase the size of its officer corps. If the best that can be hoped for is the *status quo*, then effort will have to be made to increase accessions and minimize losses. The effects of bonuses and other incentives on recruiting and retention might be an area warranting further study.

With current officer shortages and future shortages projected, certain roles and responsibilities will be either carried out by others or not assigned to anyone. There may be a need for a review of the officer positions in the Army Reserve.

All units in the Army are classified into two types. The first is a Table of Distributions and Allowances (TDA). A TDA unit is a non-deploying garrison asset and includes the Army's civilian workforce. The second is a Table of Organization and Equipment (TOE). A TOE unit is a deployable warfighting asset. Commanders can formally request changes to their organizational structures, or changes to their structures can be mandated from a higher headquarters. Similar to the civilian sector's business practice of Lean Six Sigma, the federal government has a tool called an A76 study that is used to assess an organization's personnel assignments. A task review board is conducted for each duty position that lists the duties contained in an employee or

Soldier's job description. Based on the contents of the list, recommendations are made on the necessity of the duty position. This tool is typically employed at unit level when there is a reorganization or reduction in force.

If the Army Reserve were to study its manpower needs, there might be a reduction in the required staffing levels. Positions deemed unessential or those that could be absorbed into another duty position could be eliminated. This action would not decrease the size of the force, but decrease the number of positions the members of the force are expected to fill. With the less important positions eliminated, the focus can be on filling the key and essential positions that are needed to keep the Army Reserve trained and ready for war.

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APPENDIX A ACCESSIONS PROJECTIONS

The following tables and graphs were created from accessions data provided by the USARC G1. All bold numbers are the given data points. All other values were calculated using the technique in the title of the table. All optimal values for α and β were calculated and applied.

Year	2LT	1LT	CPT	MAJ	LTC	Total
2003	**1068**	**814**	**1268**	**572**	**233**	3955
2004	**1009**	**550**	**927**	**492**	**251**	3229
2005	**1410**	**341**	**551**	**367**	**212**	2881
2006	**1478**	**468**	**757**	**439**	**235**	3377
2007	**700**	**490**	**927**	**578**	**393**	3088

Table 7. Accessions data

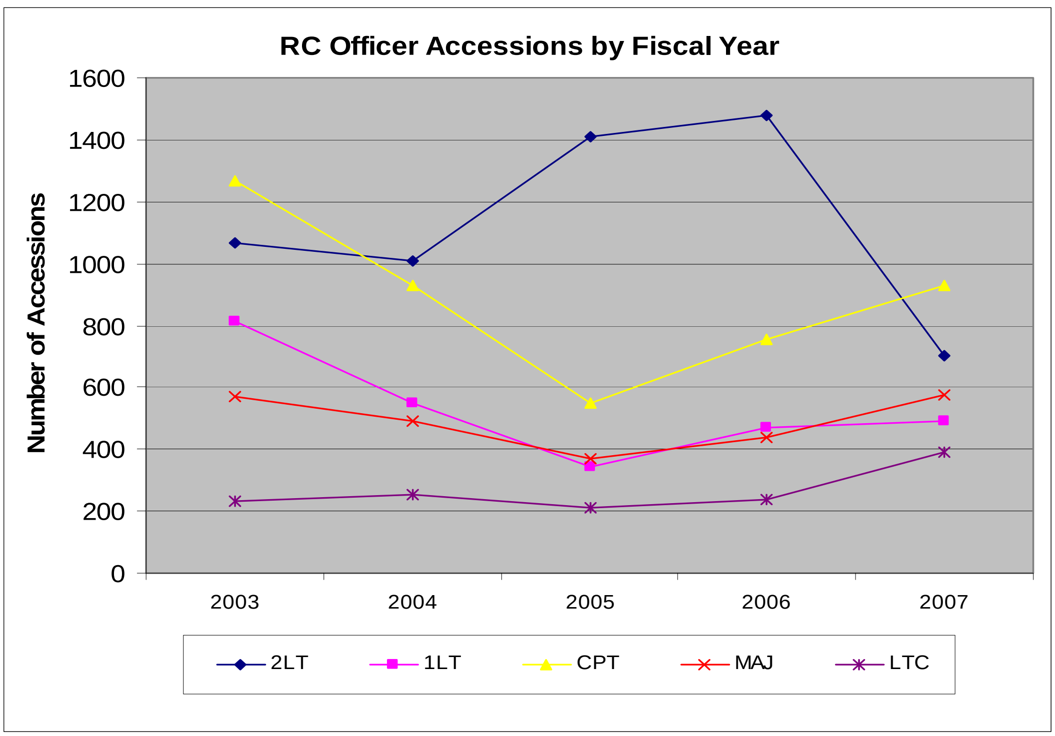

Figure 12. Accessions Data

	2LT	1LT	CPT	MAJ	LTC	Total
2003	**1068**	**814**	**1268**	**572**	**233**	3955
2004	**1009**	**550**	**927**	**492**	**251**	3229
2005	**1410**	**341**	**551**	**367**	**212**	2881
2006	1162	568	915	477	232	3355
2007	1194	486	798	445	232	3155
2008	1255	465	755	430	225	3130
2009	1204	507	823	451	230	3213
2010	1218	486	792	442	229	3166
2011	1226	486	790	441	228	3170
2012	1216	493	801	444	229	3183

Table 8. Accessions Forecasts (Three-Year Moving Average)

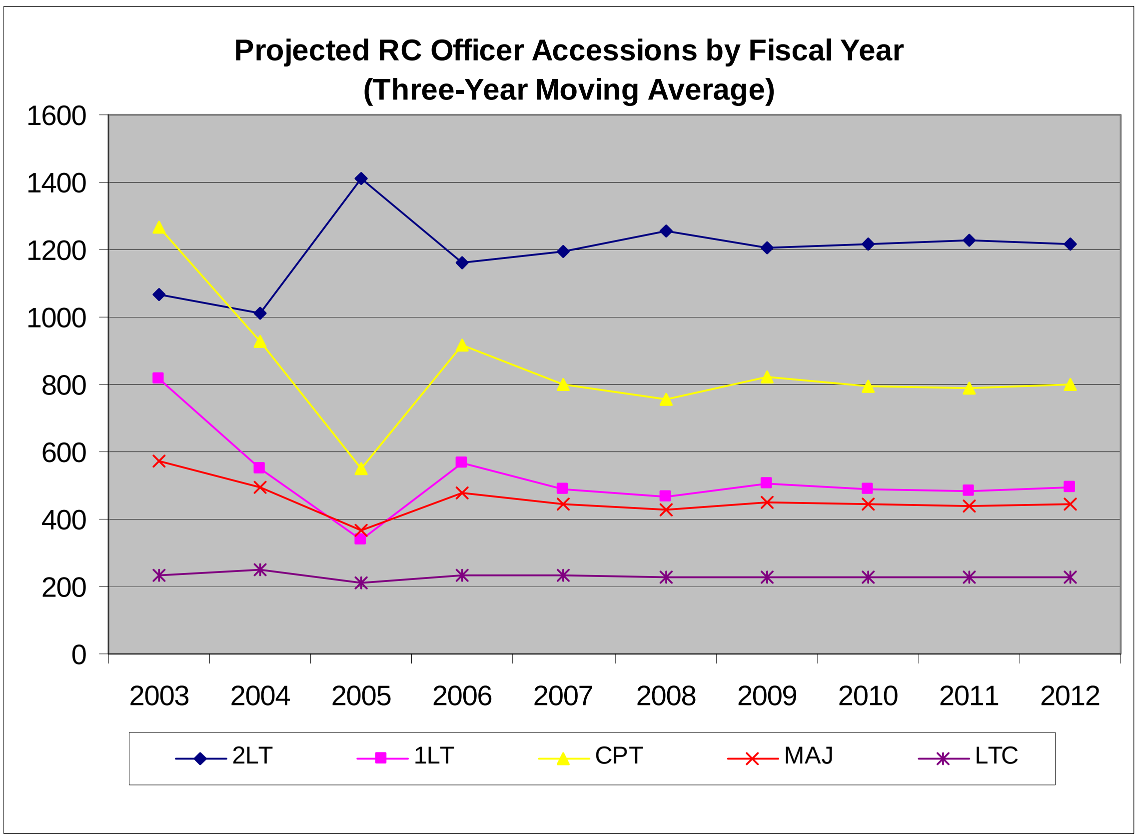

Figure 13. Accessions Forecasts (Three-Year Moving Average)

	2LT	1LT	CPT	MAJ	LTC	Total
2003	**1068**	**814**	**1268**	**572**	**233**	3955
2004	**1009**	**550**	**927**	**492**	**251**	3229
2005	**1410**	**341**	**551**	**367**	**212**	2881
2006	**1478**	**468**	**757**	**439**	**235**	3377
2007	**700**	**490**	**927**	**578**	**393**	3088
2008	1053	314	630	477	356	2830
2009	1026	241	545	473	386	2672
2010	1000	168	460	469	417	2513
2011	973	95	375	465	447	2354
2012	946	22	290	461	478	2196

Table 9. Accessions Forecasts (Linear Regression)

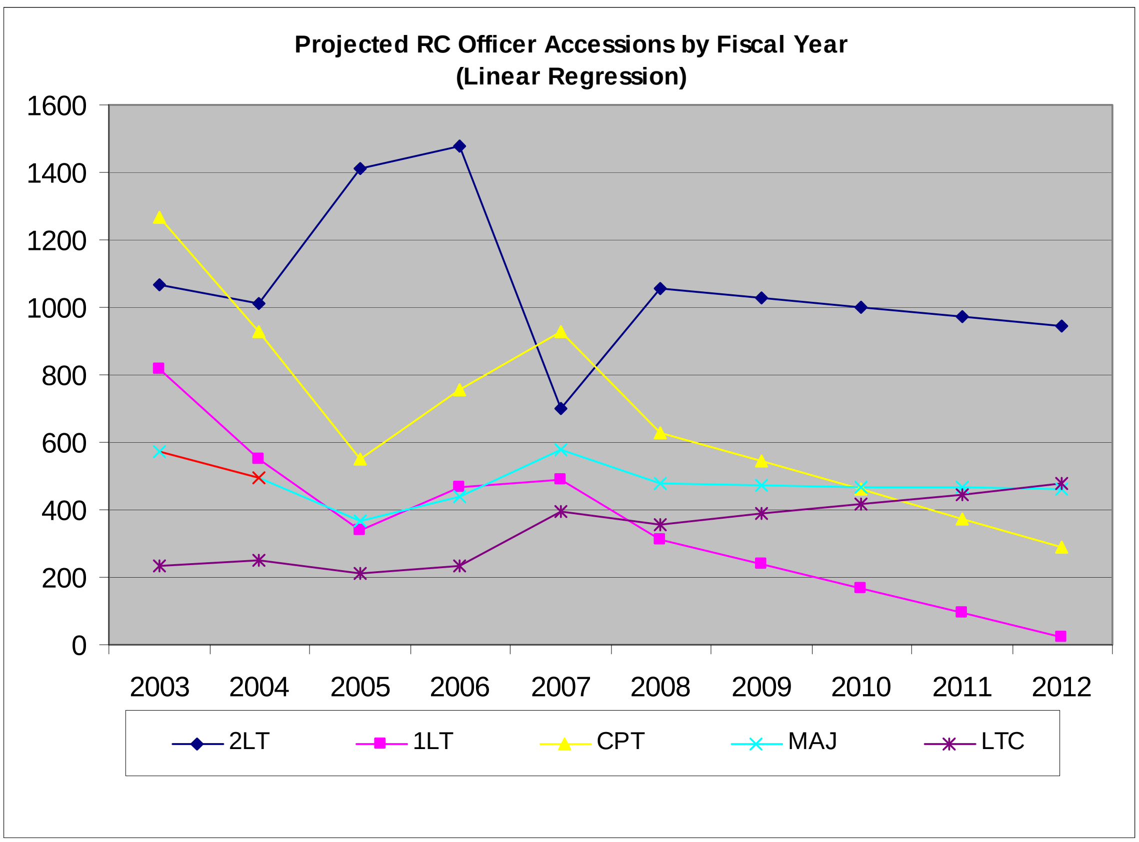

Figure 14. Accessions Forecasts (Linear Regression)

	2LT	1LT	CPT	MAJ	LTC	Total
2003	**1068**	**814**	**1268**	**572**	**233**	3955
2004	**1009**	**550**	**927**	**492**	**251**	3229
2005	**1410**	**341**	**551**	**367**	**212**	2881
2006	**1478**	**468**	**757**	**439**	**235**	3377
2007	1514	341	563	375	227	3020
2008	996	432	769	495	322	3014
2009	799	505	941	579	388	3213
2010	700	479	919	592	424	3114
2011	793	479	898	572	398	3141
2012	691	501	966	613	439	3211

Table 10. Accessions Forecasts (Four-Year Log Model)

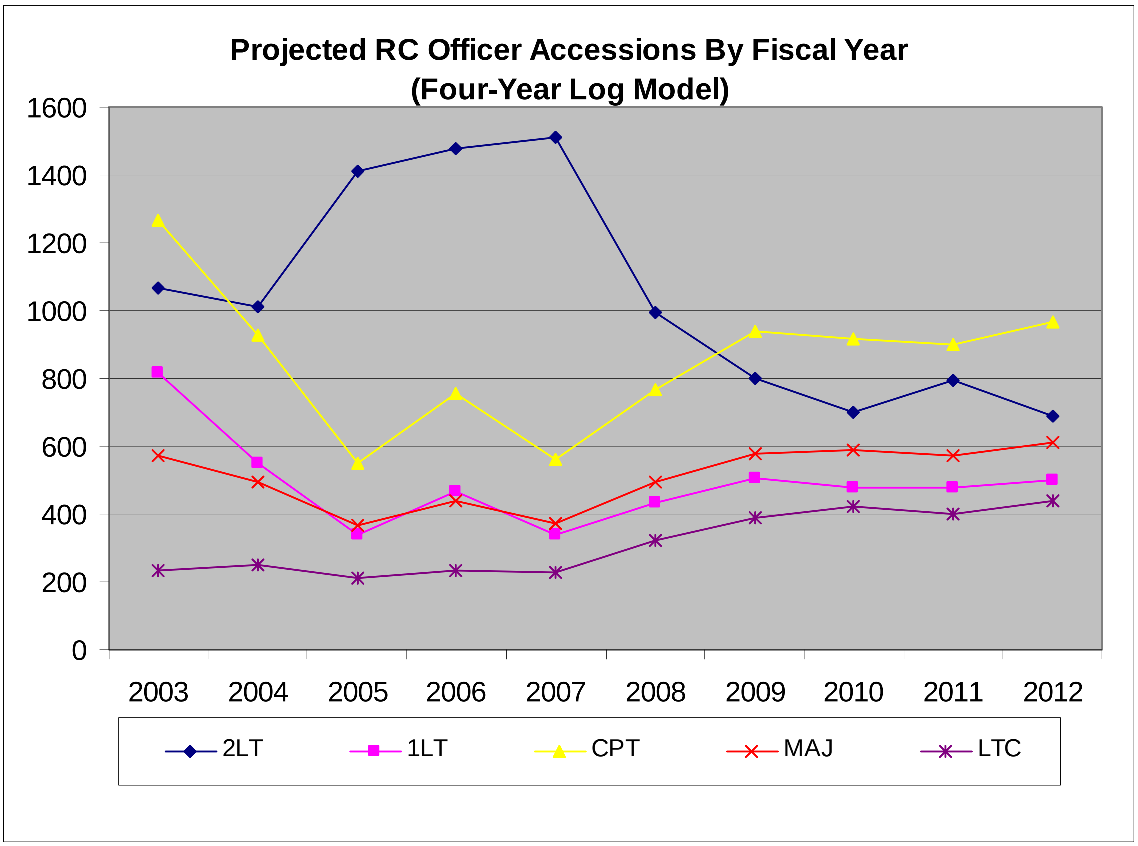

Figure 15. Accessions Forecasts (Four-Year Log Model)

	2LT	1LT	CPT	MAJ	LTC	Total
2003	**1068**	**814**	**1268**	**572**	**233**	3955
2004	1068	814	1268	572	233	3955
2005	1068	550	927	492	233	3270
2006	1068	341	551	367	233	2560
2007	1068	468	757	439	233	2965
2008	1068	490	927	578	233	3296
2009	1068	490	927	578	233	3296
2010	1068	490	927	578	233	3296
2011	1068	490	927	578	233	3296
2012	1068	490	927	578	233	3296

Table 11. Accessions Forecasts (Exponential Smoothing)

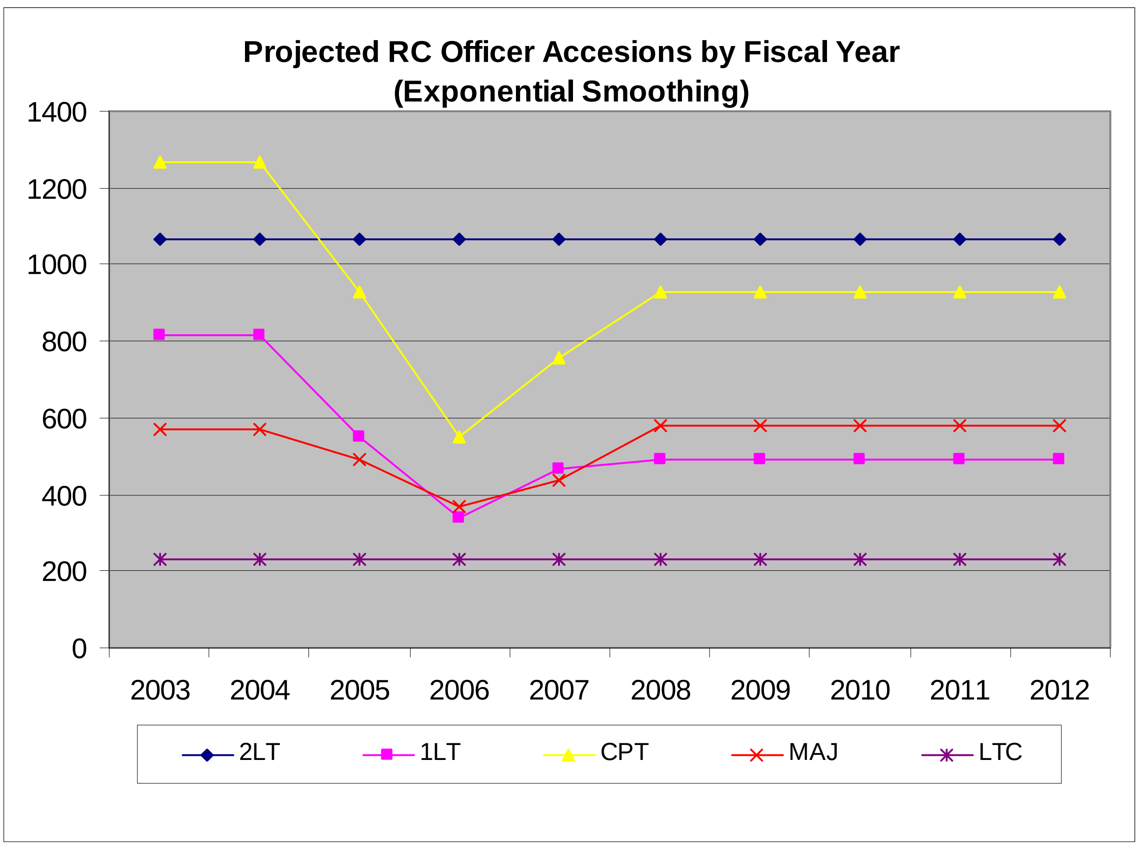

Figure 16. Accessions Forecasts (Exponential Smoothing)

	2LT	1LT	CPT	MAJ	LTC	Total
2003	**1068**	**814**	**1268**	**572**	**233**	3955
2004	950	550	1085	572	233	3389
2005	891	418	671	412	269	2661
2006	832	209	239	242	173	1696
2007	773	297	685	511	258	2524
2008	714	449	967	717	551	3397
2009	655	504	1006	856	709	3730
2010	596	559	1046	995	867	4063
2011	537	614	1086	1134	1025	4395
2012	478	669	1125	1273	1183	4728

Table 12. Accessions Forecasts (Holt Smoothing)

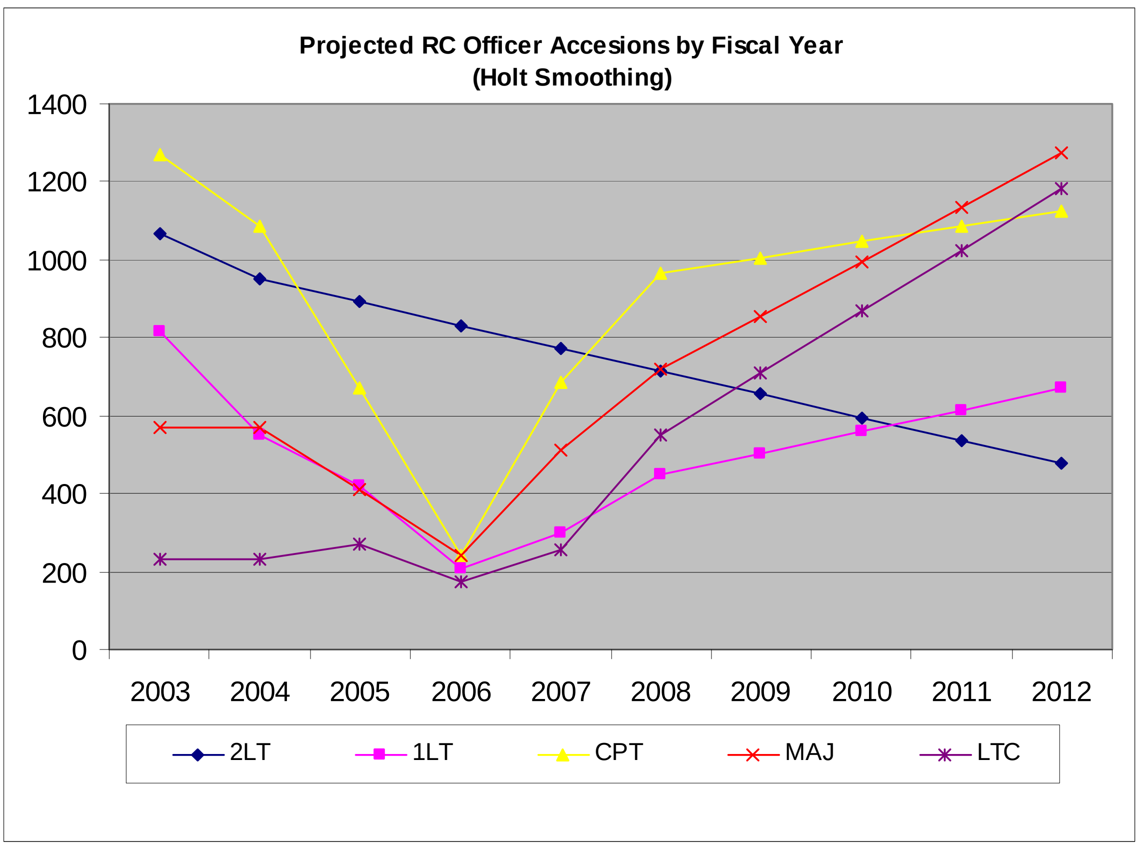

Figure 17. Accessions Forecasts (Holt Smoothing)

APPENDIX B PROMOTION PROJECTIONS

The following tables and graphs were created from promotion data provided by the Analysis, Transformation, and Integration Directorate at HRC-STL. All bold numbers are the given data points. Promotions to 1LT from 2003-2006 were calculated using the Derivation of the Personnel Flow Function shown in Figure 4. All other values were calculated using the technique in the title of the table. All optimal values for α and β were calculated and applied.

Prom. To	1LT	CPT	MAJ	LTC	COL	Total
2003	**213**	**278**	**1056**	**908**	**114**	2569
2004	**188**	**283**	**769**	**952**	**433**	2625
2005	**387**	**250**	**883**	**866**	**274**	2660
2006	**149**	**553**	**738**	**763**	**281**	2484
2007	**818**	**1022**	**610**	**273**	**83**	2806

Table 13. Promotion data

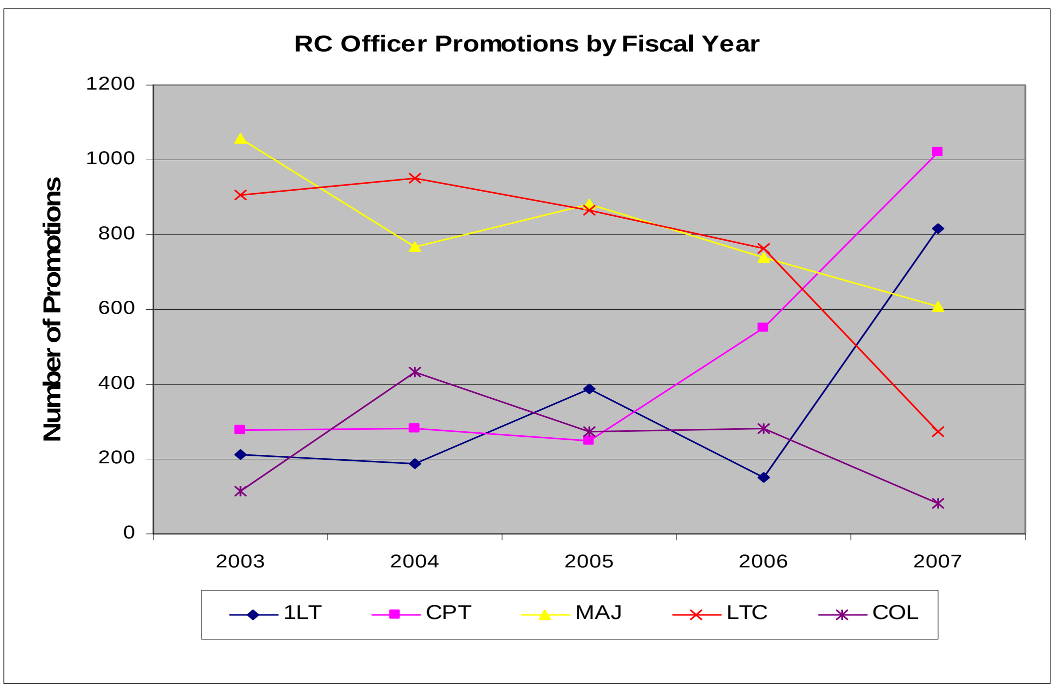

Figure 18. Promotion Data

	1LT	CPT	MAJ	LTC	COL	Total
2003	**213**	**278**	**1056**	**908**	**114**	2569
2004	**188**	**283**	**769**	**952**	**433**	2625
2005	**387**	**250**	**883**	**866**	**274**	2660
2006	263	270	903	909	274	2618
2007	241	362	797	860	329	2590
2008	451	608	744	634	213	2650
2009	473	728	697	557	192	2647
2010	581	786	684	488	163	2701
2011	502	707	708	560	189	2666
2012	518	740	696	535	181	2671

Table 14. Promotion Forecasts (Three-Year Moving Average)

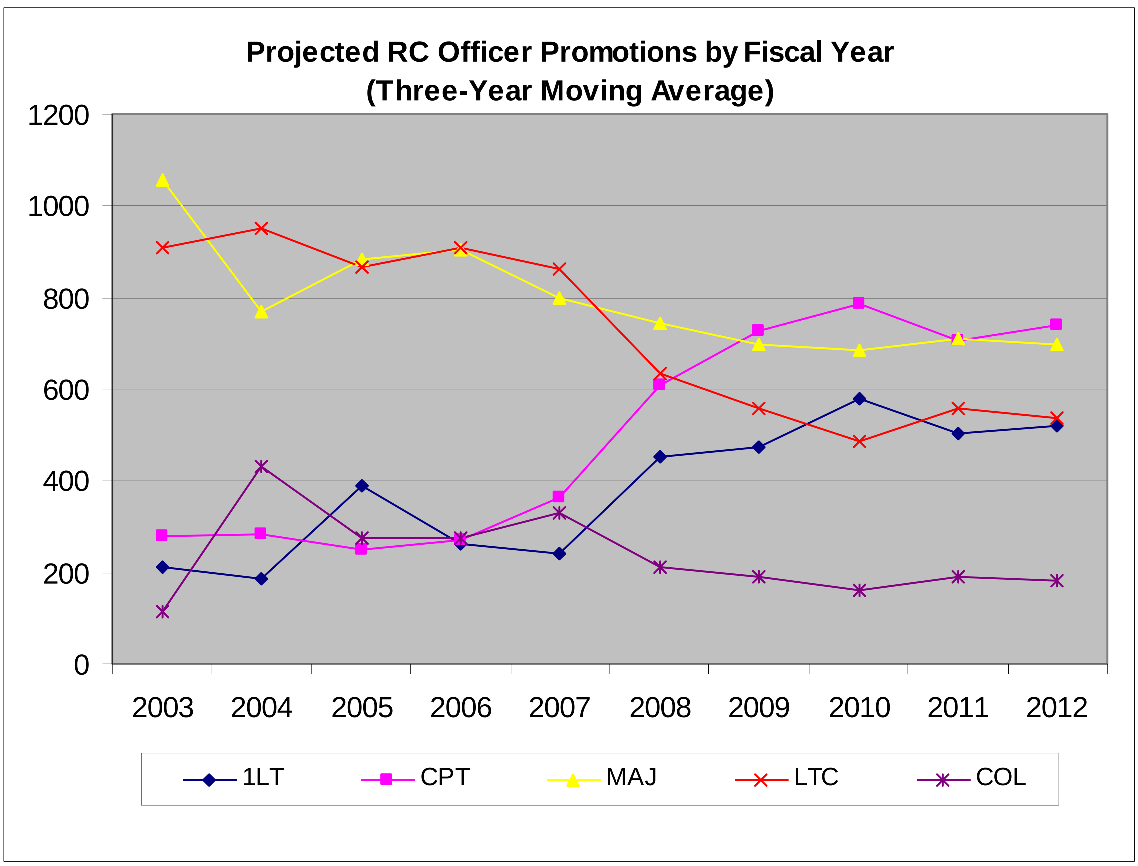

Figure 19. Promotion Forecasts (Three-Year Moving Average)

	1LT	CPT	MAJ	LTC	COL	Total
2003	**213**	**278**	**1056**	**908**	**114**	2569
2004	**188**	**283**	**769**	**952**	**433**	2625
2005	**387**	**250**	**883**	**866**	**274**	2660
2006	**149**	**553**	**738**	**763**	**281**	2484
2007	**818**	**1022**	**610**	**273**	**83**	2806
2008	702	1005	534	315	173	2729
2009	819	1180	442	169	151	2762
2010	937	1356	350	23	130	2795
2011	1054	1532	257	-123	109	2829
2012	1171	1708	165	-269	87	2862

Table 15. Promotion Forecasts (Linear Regression)

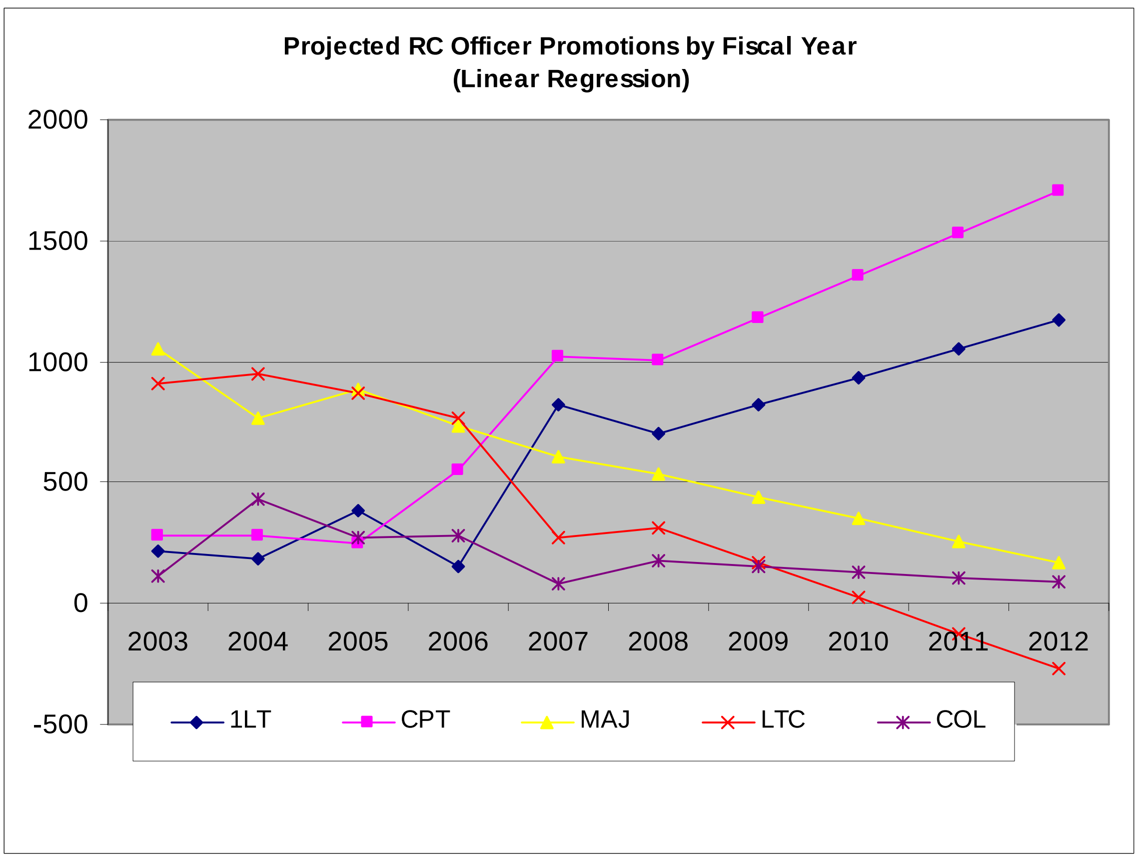

Figure 20. Promotion Forecasts (Linear Regression)

	1LT	CPT	MAJ	LTC	COL	Total
2003	**213**	**278**	**1056**	**908**	**114**	2569
2004	**188**	**283**	**769**	**952**	**433**	2625
2005	**387**	**250**	**883**	**866**	**274**	2660
2006	**149**	**553**	**738**	**763**	**281**	2484
2007	216	1052	715	793	409	3186
2008	530	931	658	354	103	2575
2009	583	1404	584	262	79	2912
2010	949	1509	574	210	58	3300
2011	715	1535	581	233	66	3129
2012	877	1782	554	196	55	3464

Table 16. Promotion Forecasts (Four-Year Log Model)

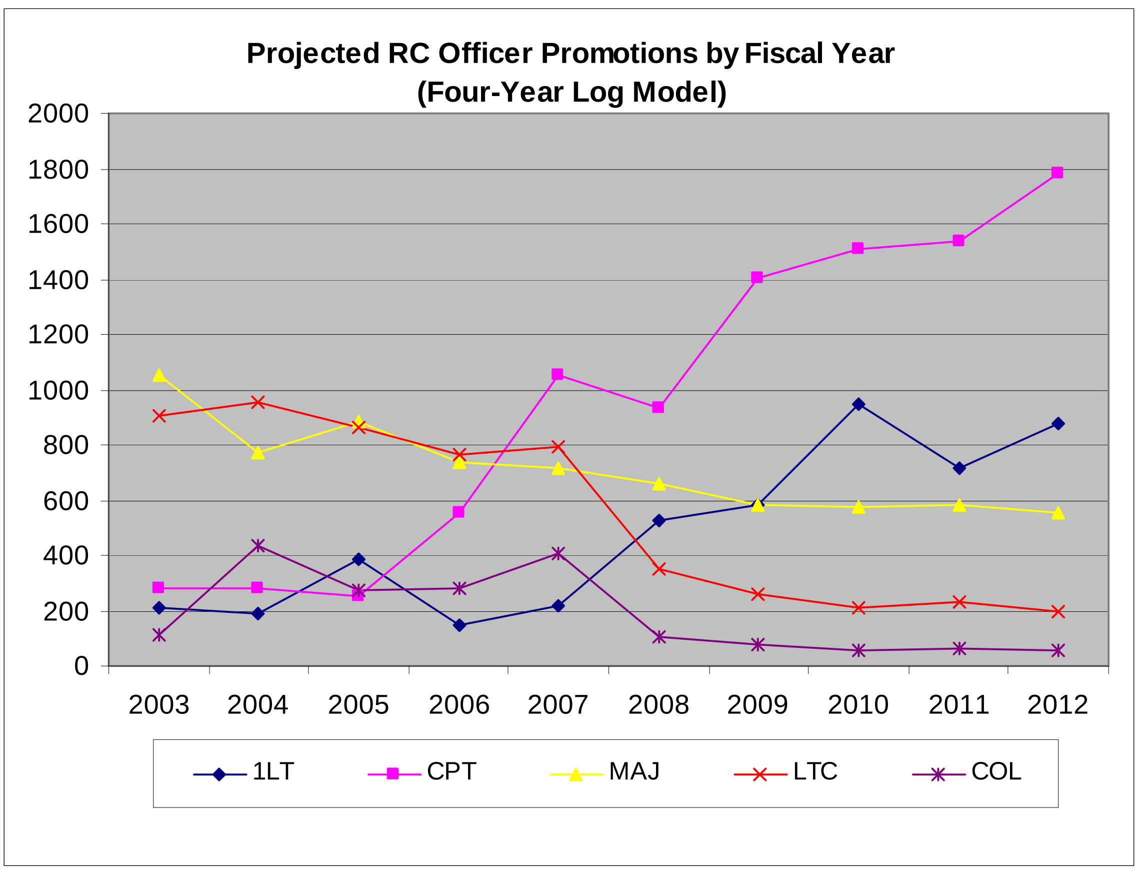

Figure 21. Promotion Forecasts (Four-Year Log Model)

	1LT	CPT	MAJ	LTC	COL	Total
2003	**213**	**278**	**1056**	**908**	**114**	2569
2004	213	278	1056	908	114	2569
2005	208	283	820	952	197	2460
2006	244	250	872	866	217	2448
2007	225	553	762	763	234	2536
2008	342	1022	637	273	194	2469
2009	342	1022	637	273	194	2469
2010	342	1022	637	273	194	2469
2011	342	1022	637	273	194	2469
2012	342	1022	637	273	194	2469

Table 17. Promotion Forecasts (Exponential Smoothing)

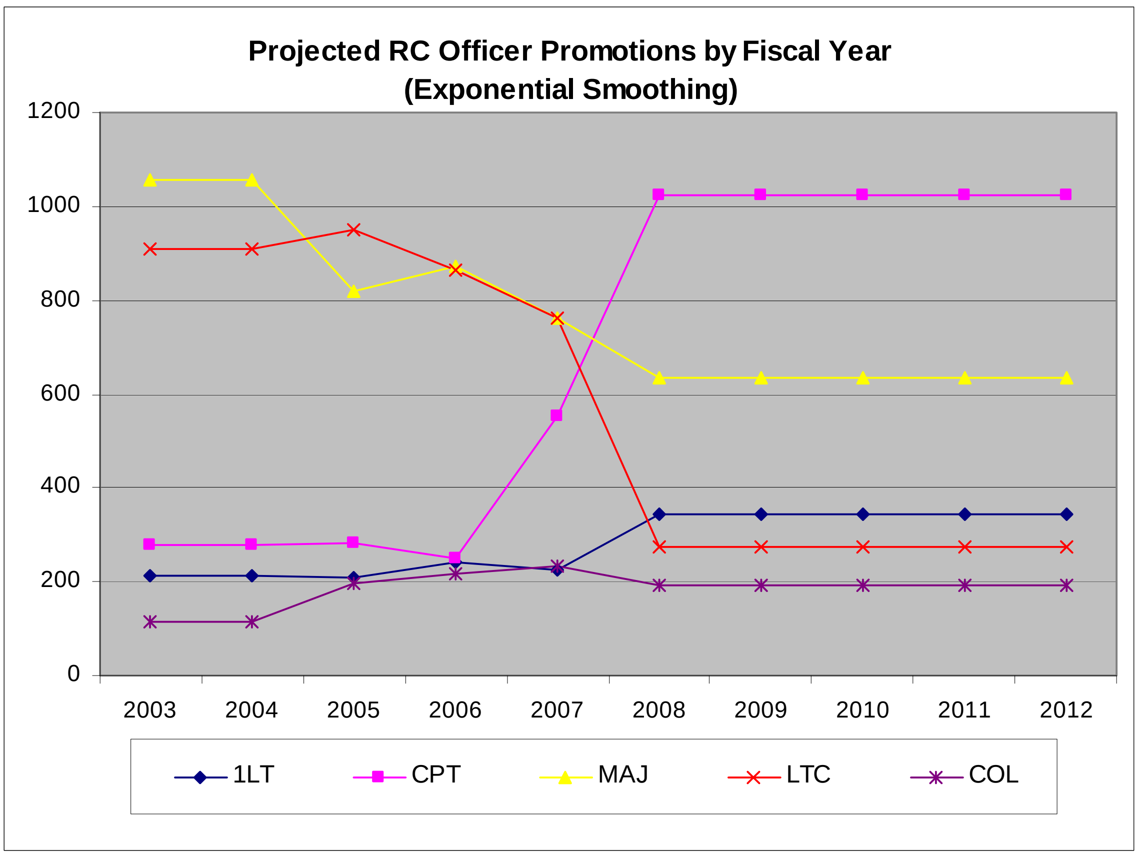

Figure 22. Promotion Forecasts (Exponential Smoothing)

	1LT	CPT	MAJ	LTC	COL	Total
2003	**213**	**278**	**1056**	**908**	**114**	2569
2004	179	278	808	916	345	2526
2005	168	288	640	986	573	2654
2006	294	217	770	804	363	2448
2007	257	856	726	657	239	2735
2008	626	1491	568	-155	-31	2499
2009	815	1960	476	-615	-203	2434
2010	1005	2429	385	-1076	-374	2369
2011	1194	2898	293	-1536	-545	2304
2012	1383	3367	201	-1997	-716	2239

Table 18. Promotion Forecasts (Holt Smoothing)

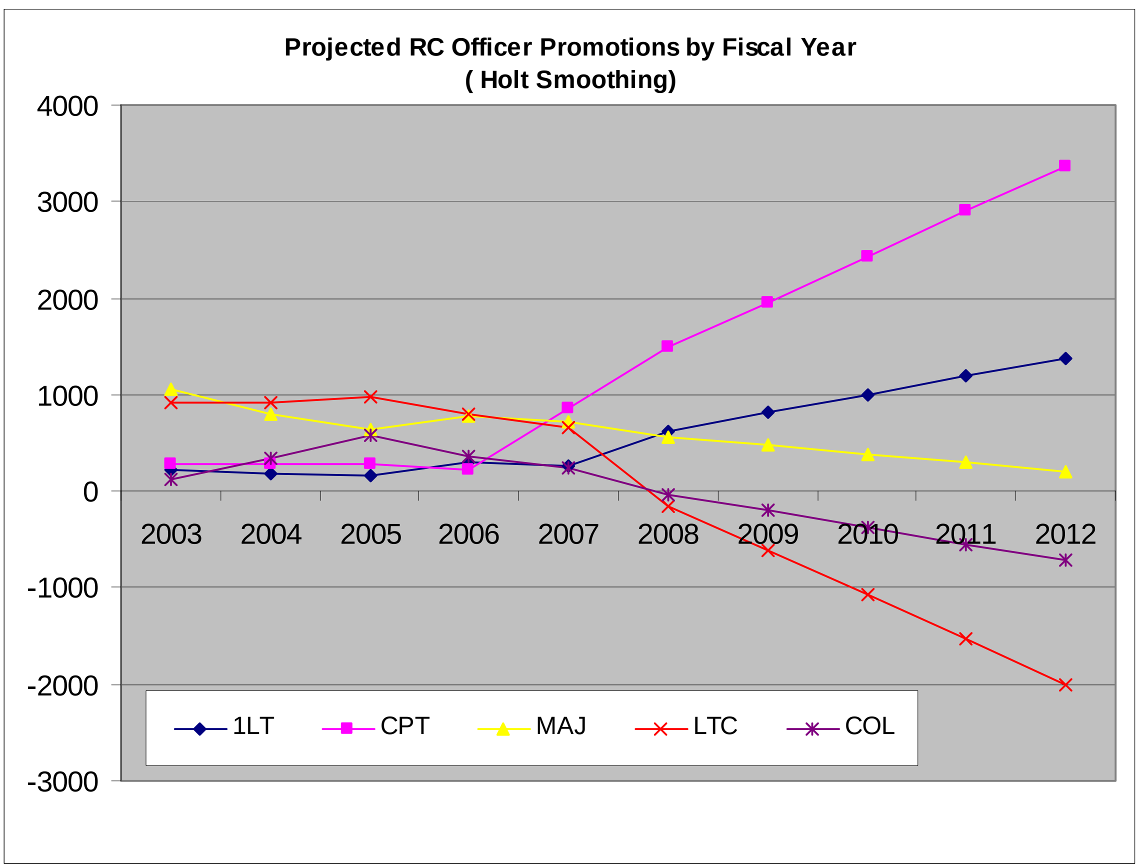

Figure 23. Promotion Forecasts (Holt Smoothing)

APPENDIX C LOSS PROJECTIONS

The following tables and graphs were created from loss data provided by the USARC G1. All bold numbers are the given data points. All other values were calculated using the technique in the title of the table. All optimal values for α and β were calculated and applied.

Losses	2LT	1LT	CPT	MAJ	LTC	Total
2003	**546**	**608**	**1361**	**1058**	**844**	4417
2004	**655**	**578**	**1382**	**1321**	**995**	4931
2005	**677**	**443**	**1122**	**1255**	**1006**	4503
2006	**909**	**391**	**827**	**862**	**776**	3765
2007	**441**	**405**	**1000**	**892**	**991**	3729

Table 19. Loss data

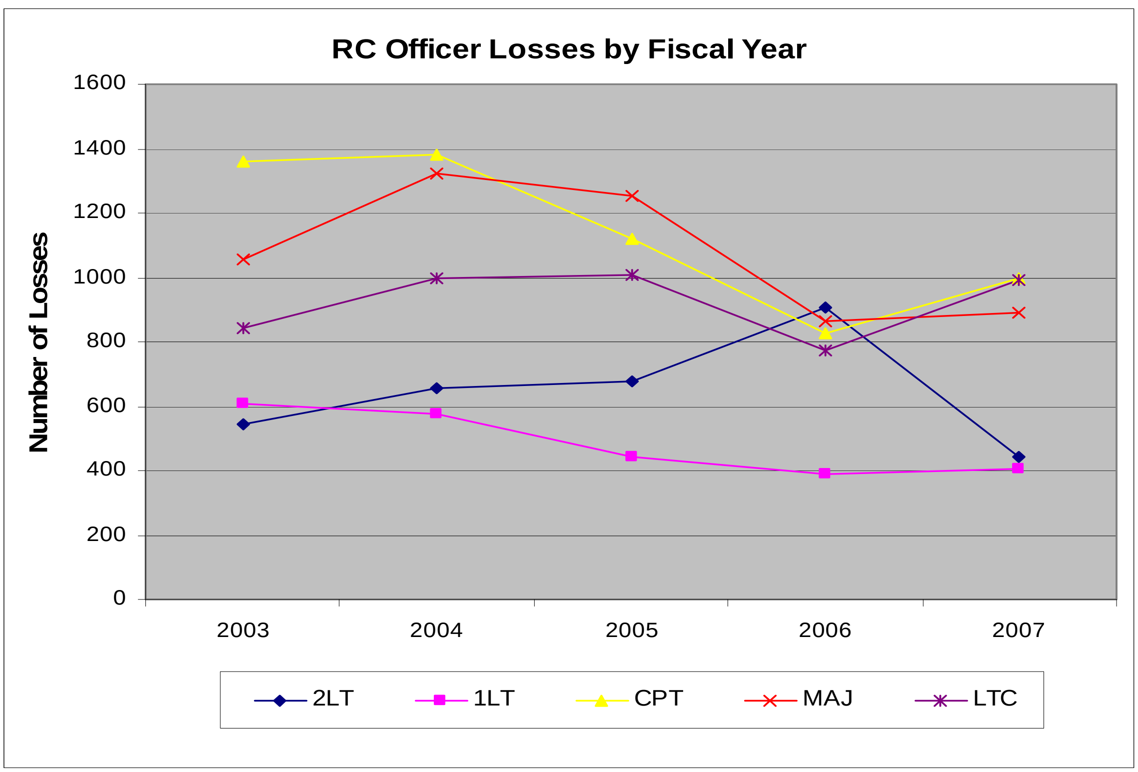

Figure 24. Loss Data

	2LT	1LT	CPT	MAJ	LTC	Total
2003	**546**	**608**	**1361**	**1058**	**844**	4417
2004	**655**	**578**	**1382**	**1321**	**995**	4931
2005	**677**	**443**	**1122**	**1255**	**1006**	4503
2006	626	543	1288	1211	948	4617
2007	747	471	1110	1146	926	4400
2008	676	413	983	1003	924	3999
2009	675	403	937	919	897	3831
2010	597	407	973	938	937	3853
2011	649	408	964	953	920	3894
2012	641	406	958	937	918	3859

Table 20. Loss Forecasts (Three-Year Moving Average)

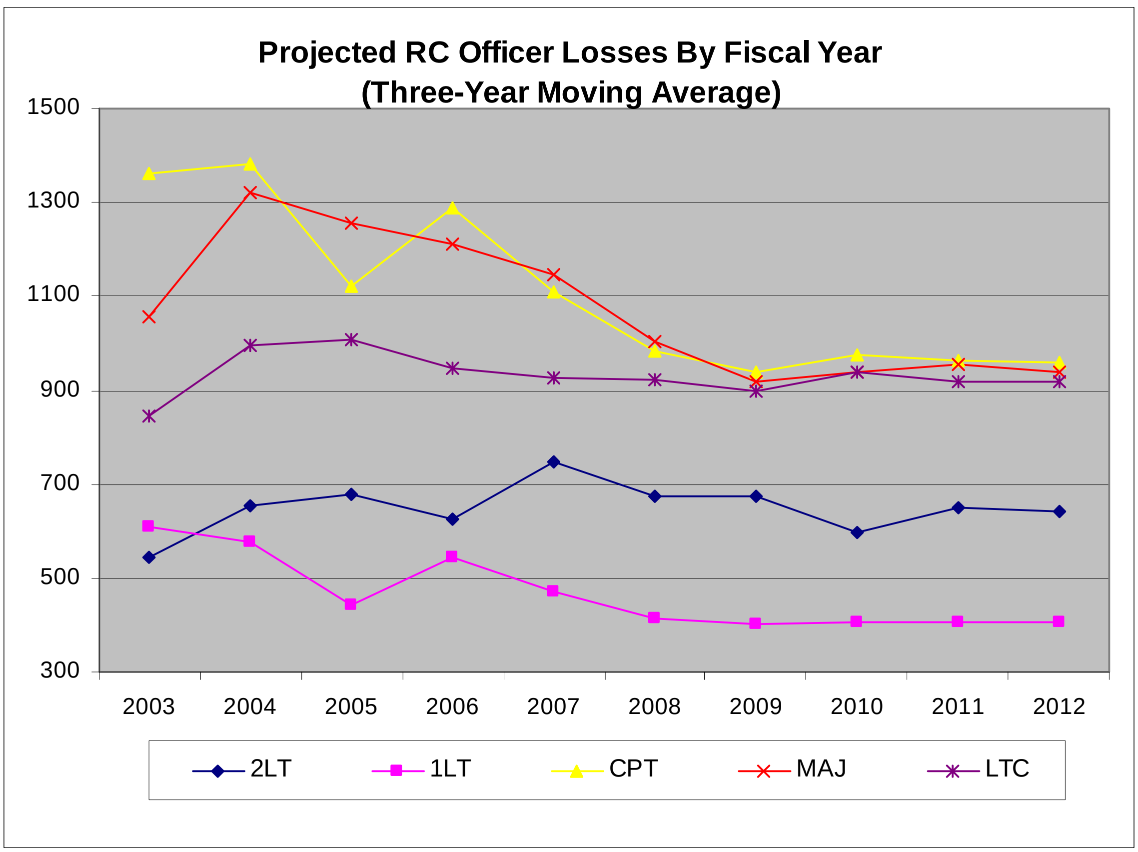

Figure 25. Loss Forecasts (Three-Year Moving Average)

	2LT	1LT	CPT	MAJ	LTC	Total
2003	**546**	**608**	**1361**	**1058**	**844**	4417
2004	**655**	**578**	**1382**	**1321**	**995**	4931
2005	**677**	**443**	**1122**	**1255**	**1006**	4503
2006	**909**	**391**	**827**	**862**	**776**	3765
2007	**441**	**405**	**1000**	**892**	**991**	3729
2008	659	307	755	840	945	3506
2009	663	248	628	761	952	3252
2010	668	189	500	682	960	2998
2011	672	129	372	603	967	2744
2012	676	70	245	524	975	2490

Table 21. Loss Forecasts (Linear Regression)

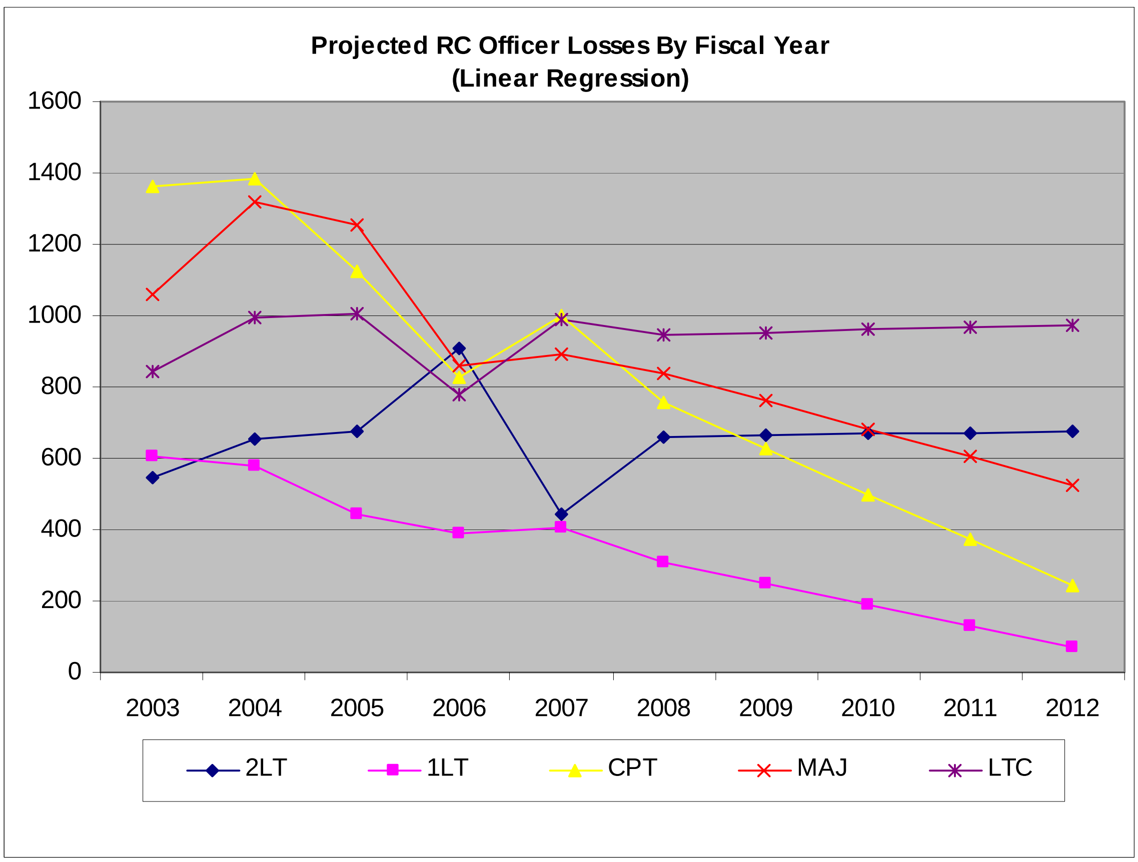

Figure 26. Loss Forecasts (Linear Regression)

	2LT	1LT	CPT	MAJ	LTC	Total
2003	**546**	**608**	**1361**	**1058**	**844**	4417
2004	**655**	**578**	**1382**	**1321**	**995**	4931
2005	**677**	**443**	**1122**	**1255**	**1006**	4503
2006	**909**	**391**	**827**	**862**	**776**	3765
2007	890	381	880	1035	891	4077
2008	585	358	833	812	883	3471
2009	525	358	818	738	872	3311
2010	406	354	851	757	934	3302
2011	405	340	787	715	876	3124
2012	373	344	807	707	900	3131

Table 22. Loss Forecasts (Four-Year Log Model)

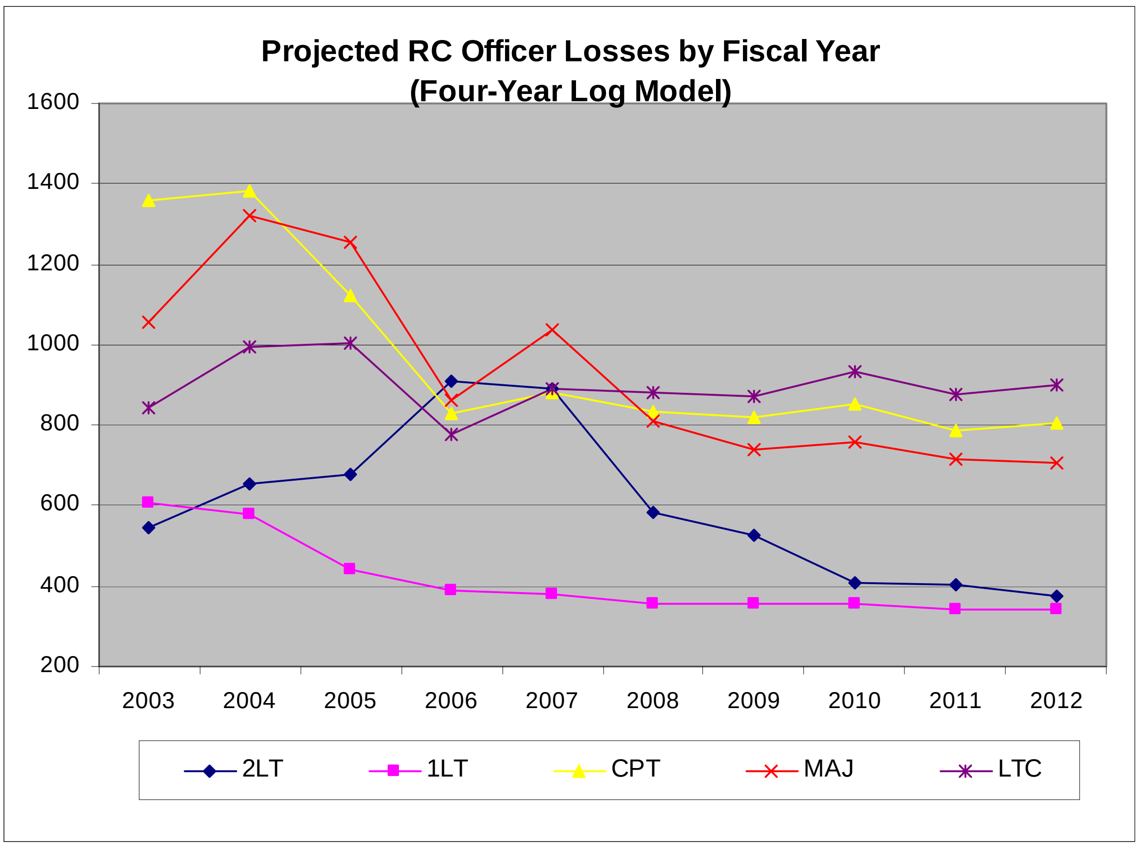

Figure 27. Loss Forecasts (Four-Year Log Model)

	2LT	1LT	CPT	MAJ	LTC	Total
2003	**546**	**608**	**1361**	**1058**	**844**	4417
2004	546	608	1361	1058	844	4417
2005	557	578	1382	1058	871	4447
2006	569	443	1122	1058	896	4088
2007	604	391	827	1058	874	3754
2008	587	405	1000	1058	895	3946
2009	587	405	1000	1058	895	3946
2010	587	405	1000	1058	895	3946
2011	587	405	1000	1058	895	3946
2012	587	405	1000	1058	895	3946

Table 23. Loss Forecasts (Exponential Smoothing)

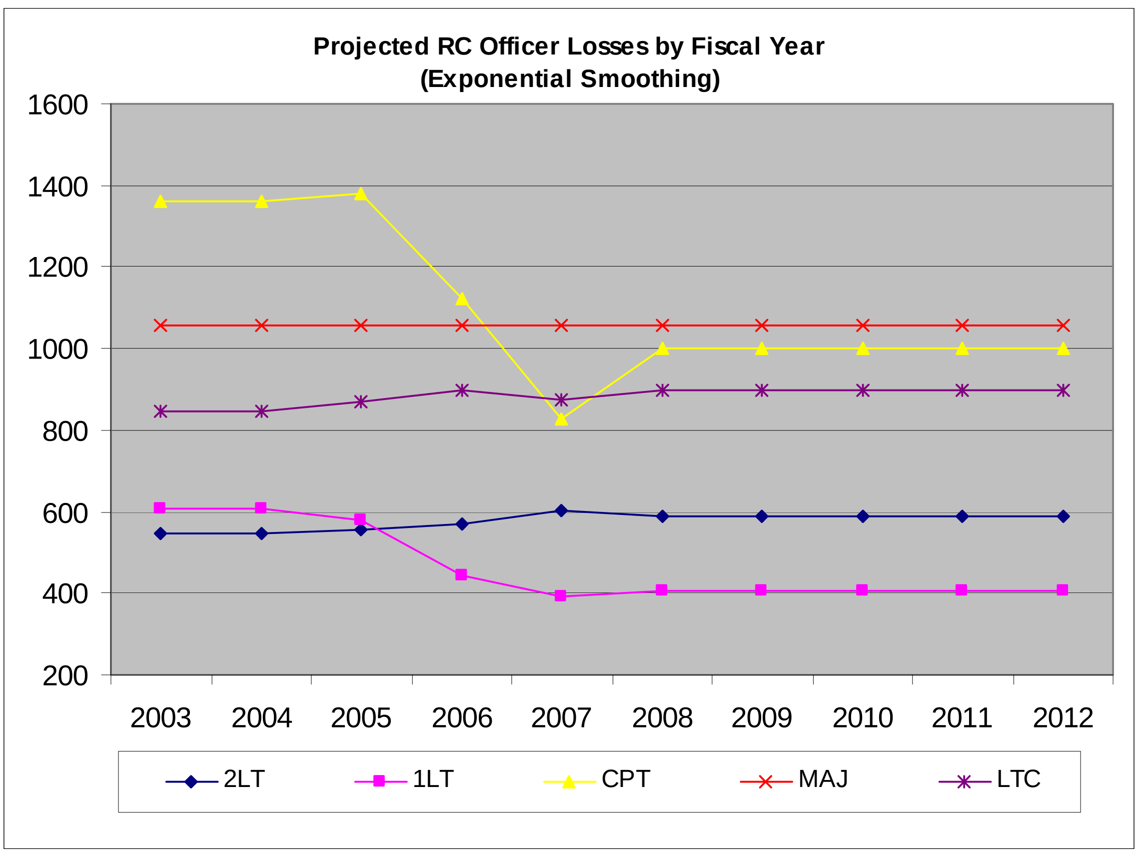

Figure 28. Loss Forecasts (Exponential Smoothing)

	2LT	1LT	CPT	MAJ	LTC	Total
2003	**546**	**608**	**1361**	**1058**	**844**	4417
2004	706	578	1382	1267	1013	4945
2005	759	548	1403	1437	1082	5227
2006	781	413	1137	1355	1092	4778
2007	894	361	837	789	857	3737
2008	731	375	1013	644	879	3641
2009	688	345	1025	437	843	3338
2010	646	315	1038	230	806	3035
2011	603	285	1050	23	769	2731
2012	561	255	1063	-184	733	2428

Table 24. Promotion Forecasts (Holt Smoothing)

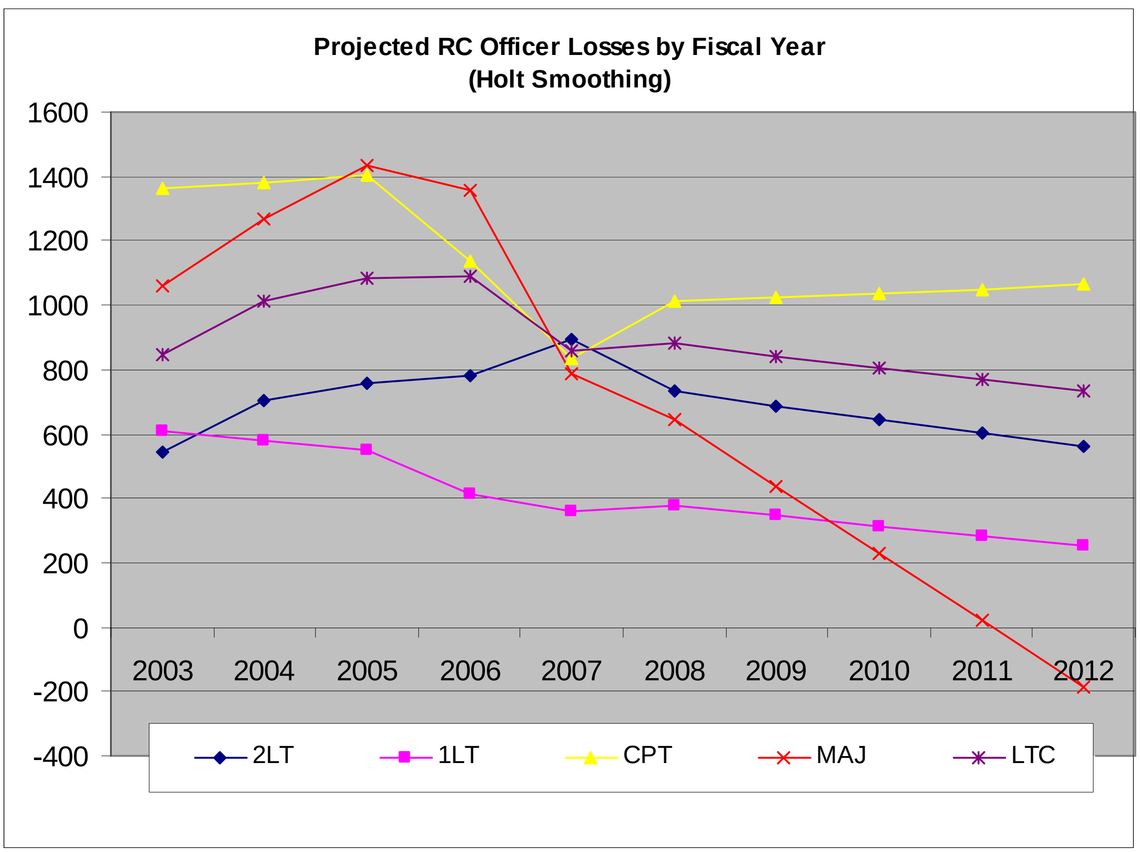

Figure 29. Loss Forecasts (Holt Smoothing)

APPENDIX D OVERALL ENDSTRENGTH PROJECTIONS

The following tables and graphs were created from overall officer endstrength data provided by the OCAR-HR, shown in Table 1 and Figure 2. All bold numbers are the given data points. All other values were calculated using the technique in the title of the table. All optimal values for α and β were calculated and applied. The maximum and minimum projected values were consolidated in a final table to show the range of predictions from the different models.

(yellow)	= maximum value in consolidated data
(orange)	= minimum value in consolidated data

Figure 30. Legend for Consolidation of Results

Year	2LT	1LT	CPT	MAJ	LTC	Total
2001	**2099**	**4703**	**10202**	**11502**	**7490**	35996
2002	**2124**	**4151**	**9946**	**11843**	**7401**	35465
2003	**2069**	**4292**	**9822**	**11790**	**7188**	35161
2004	2097	4382	9990	11712	7360	35541
2005	2092	4204	9549	11671	7192	34709
2006	2133	4222	8896	11249	7037	33537
2007	2213	4083	8302	10700	6962	32260
2008	2221	3929	8074	10147	6983	31354
2009	2212	3838	8104	10003	6999	31155
2010	2180	3825	8125	9957	7011	31098
2011	2204	3864	8101	10036	6998	31202
2012	2199	3842	8110	9999	7002	31152

Table 25. Overall Endstrength Forecasts (Three-Year Moving Average)

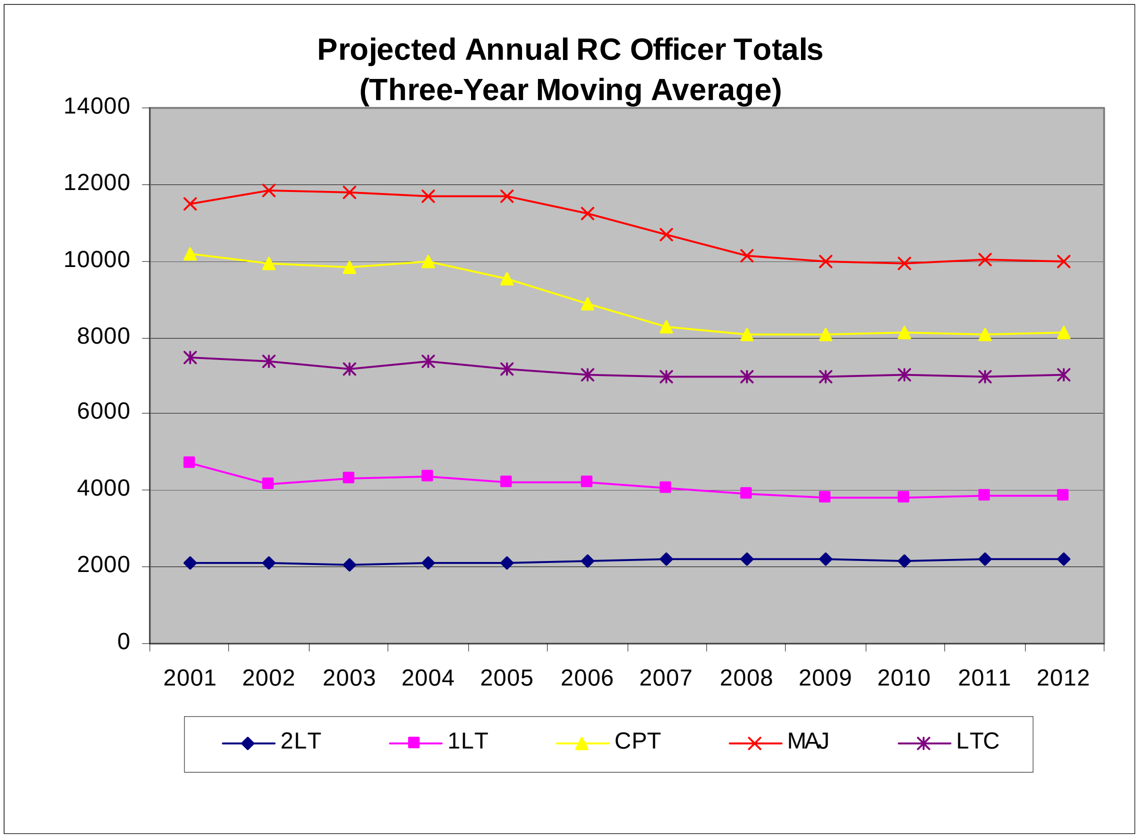

Figure 31. Overall Endstrength Forecasts (Three-Year Moving Average)

Year	2LT	1LT	CPT	MAJ	LTC	Total
2001	**2099**	**4703**	**10202**	**11502**	**7490**	35996
2002	**2124**	**4151**	**9946**	**11843**	**7401**	35465
2003	**2069**	**4292**	**9822**	**11790**	**7188**	35161
2004	**2083**	**4169**	**8879**	**11381**	**6988**	33500
2005	**2248**	**4204**	**7986**	**10577**	**6936**	31951
2006	**2308**	**3877**	**8041**	**10141**	**6962**	31329
2007	**2107**	**3707**	**8196**	**9722**	**7051**	30783
2008	2230	3640	7344	9571	6796	29581
2009	2250	3510	6927	9216	6708	28612
2010	2271	3381	6511	8860	6621	27643
2011	2291	3252	6094	8504	6533	26675
2012	2311	3122	5678	8149	6446	25706

Table 26. Overall Endstrength Forecasts (Linear Regression)

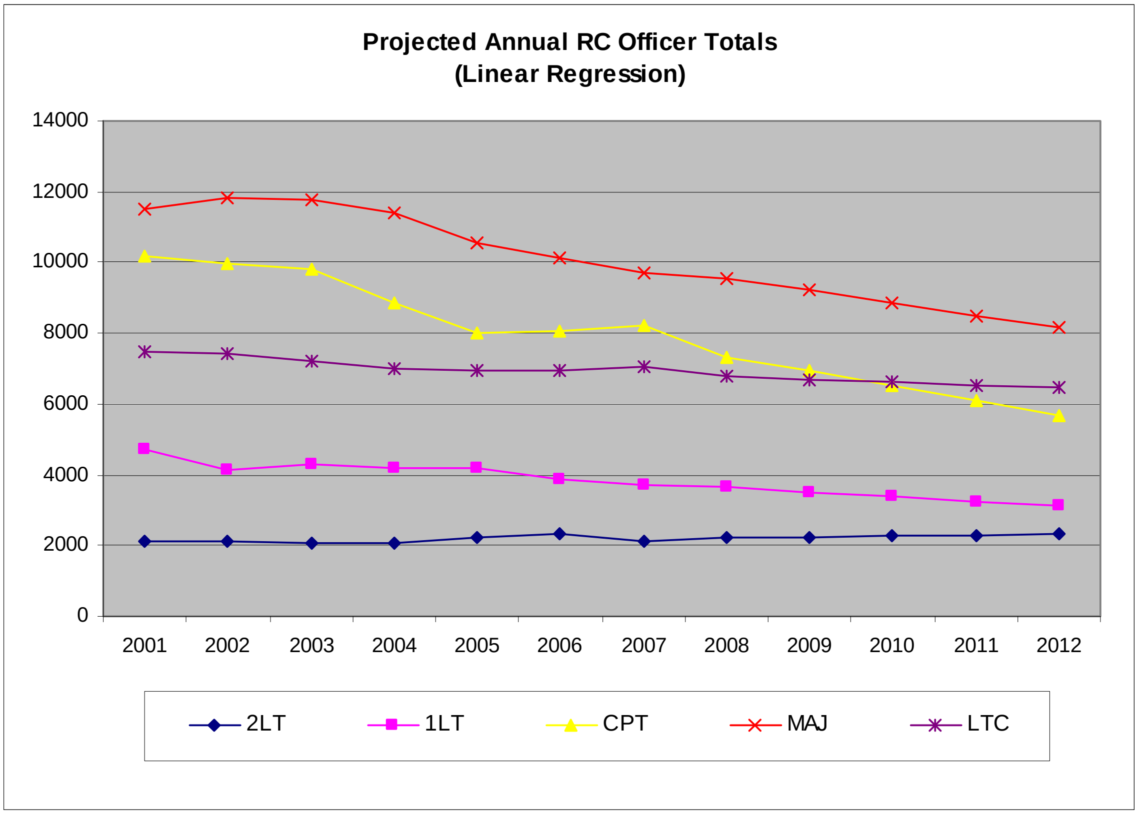

Figure 32. Overall Endstrength Forecasts (Linear Regression)

Year	2LT	1LT	CPT	MAJ	LTC	Total
2001	**2099**	**4703**	**10202**	**11502**	**7490**	35996
2002	**2124**	**4151**	**9946**	**11843**	**7401**	35465
2003	**2069**	**4292**	**9822**	**11790**	**7188**	35161
2004	**2083**	**4169**	**8879**	**11381**	**6988**	33500
2005	2078	3711	9057	11613	6984	33442
2006	2179	3625	8070	10733	6848	31456
2007	2325	3940	7607	10019	6877	30768
2008	2235	3716	7863	9531	7010	30355
2009	2180	3583	8009	9381	7047	30200
2010	2150	3569	7960	9257	7060	29996
2011	2195	3553	7886	9206	7048	29888
2012	2157	3511	7950	9150	7067	29835

Table 27. Overall Endstrength Forecasts (Four-Year Log Model)

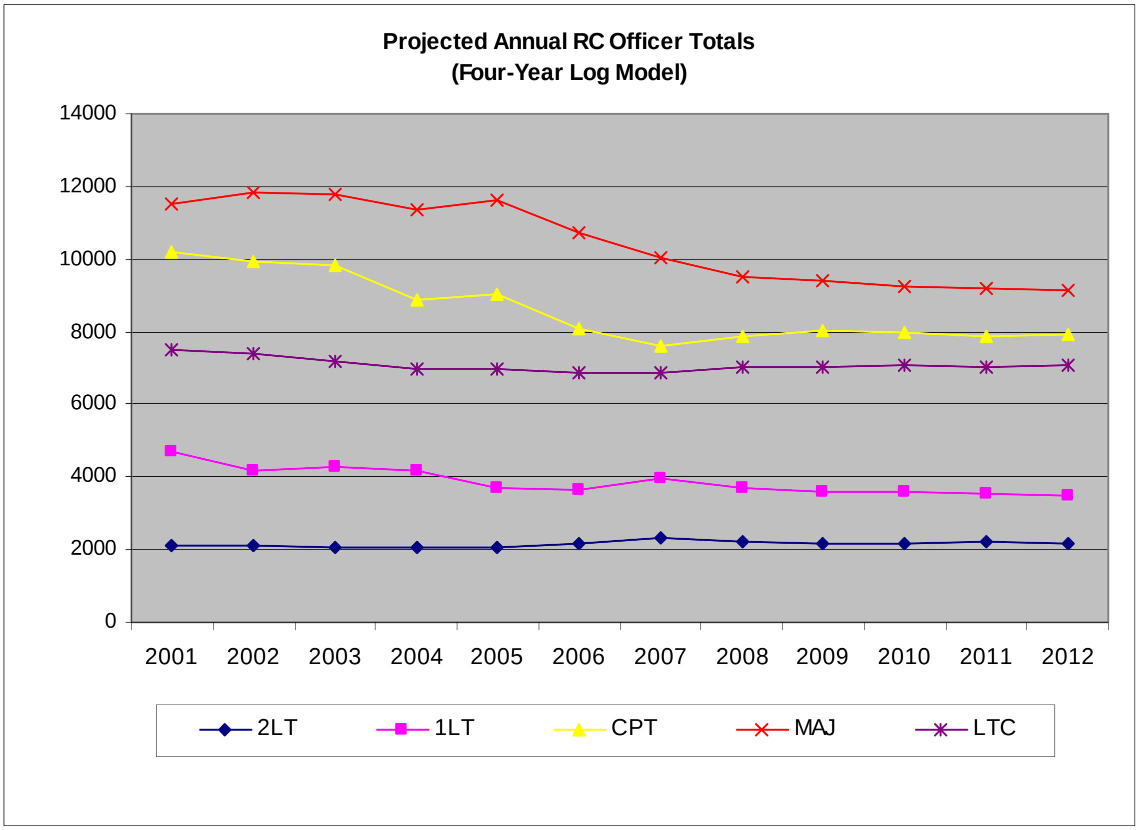

Figure 33. Overall Endstrength Forecasts (Four-Year Log Model)

Year	2LT	1LT	CPT	MAJ	LTC	Total
2001	**2099**	**4703**	**10202**	**11502**	**7490**	35996
2002	2099	4703	10202	11502	7490	35996
2003	2105	4199	9946	11843	7401	35494
2004	2096	4284	9822	11790	7188	35180
2005	2093	4179	8879	11381	6988	33520
2006	2132	4202	7986	10577	6936	31833
2007	2176	3905	8041	10141	6962	31225
2008	2159	3724	8196	9722	7051	30852
2009	2159	3724	8196	9722	7051	30852
2010	2159	3724	8196	9722	7051	30852
2011	2159	3724	8196	9722	7051	30852
2012	2159	3724	8196	9722	7051	30852

Table 28. Overall Endstrength Forecasts (Exponential Smoothing)

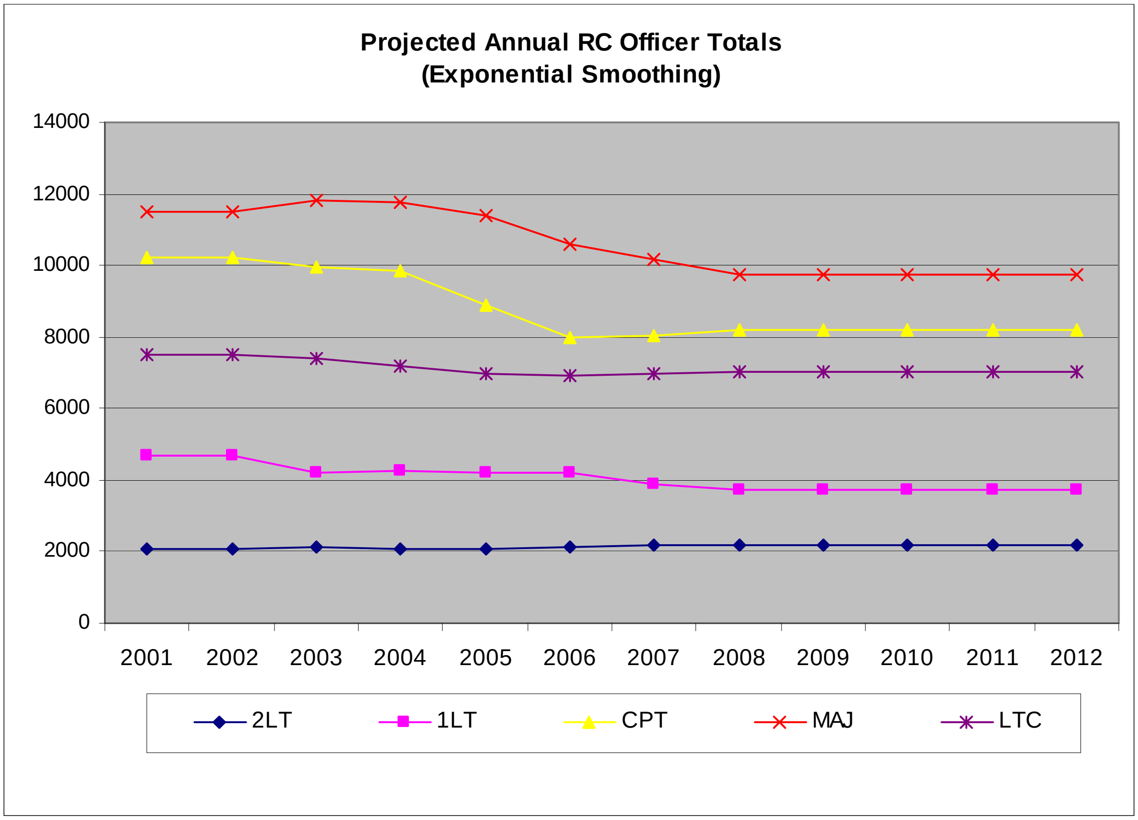

Figure 34. Overall Endstrength Forecasts (Exponential Smoothing)

Year	2LT	1LT	CPT	MAJ	LTC	Total
2001	**2099**	**4703**	**10202**	**11502**	**7490**	35996
2002	2146	4288	9946	11549	7490	35419
2003	2168	3909	9690	12144	7312	35223
2004	2179	4094	9566	11785	6975	34600
2005	2186	4133	8623	11027	6788	32758
2006	2205	4214	7730	9834	6884	30867
2007	2231	3830	7785	9663	6988	30497
2008	2239	3503	7940	9295	7140	30116
2009	2253	3252	7684	8868	7229	29286
2010	2267	3002	7428	8441	7318	28455
2011	2281	2751	7172	8014	7407	27625
2012	2295	2500	6916	7587	7496	26795

Table 29. Overall Endstrength Forecasts (Holt Smoothing)

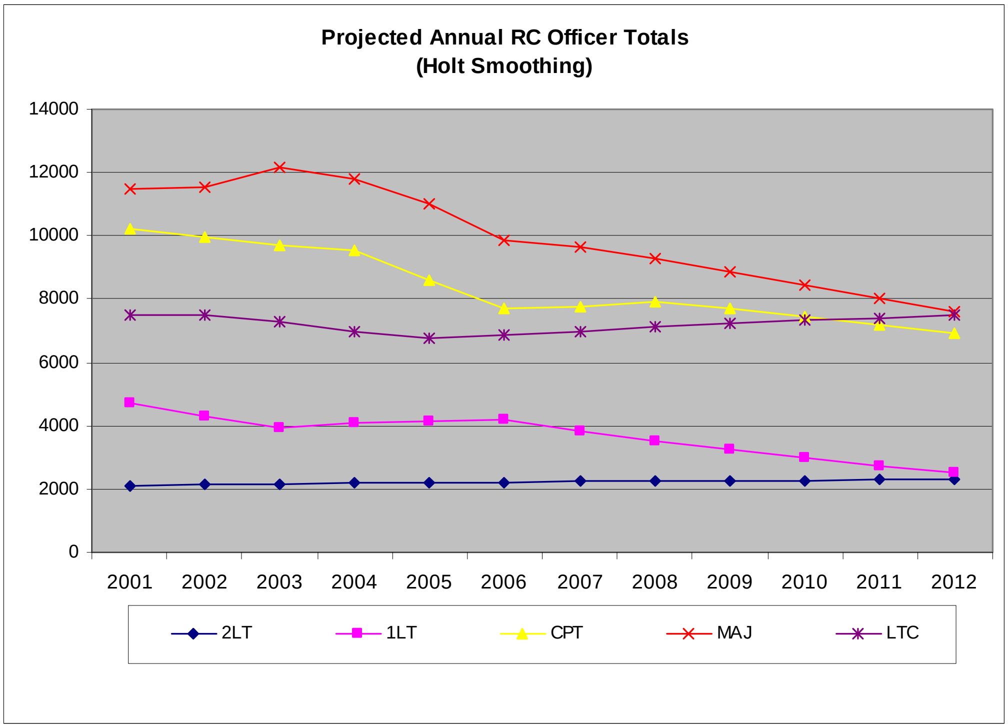

Figure 35. Overall Endstrength Forecasts (Holt Smoothing)

Year	2LT (MAX)	1LT (MAX)	CPT (MAX)	MAJ (MAX)	LTC (MAX)	Total
2008	2239	3929	8196	10147	7140	31651
2009	2253	3838	8196	10003	7229	31519
2010	2271	3825	8196	9957	7318	31567
2011	2291	3864	8196	10036	7407	31794
2012	2311	3842	8196	9999	7496	31844

Table 30. Maximum Values of Overall Endstrength Forecasts

Year	2LT (MIN)	1LT (MIN)	CPT (MIN)	MAJ (MIN)	LTC (MIN)	Total
2008	2159	3503	7344	9295	6796	29096
2009	2159	3252	6927	8868	6708	27914
2010	2150	3002	6511	8441	6621	26724
2011	2159	2751	6094	8014	6533	25551
2012	2157	2500	5678	7587	6446	24368

Table 31. Minimum Values of Overall Endstrength Forecasts

APPENDIX E OVERALL ENDSTRENGTH PROJECTIONS (COMBINED FROM SECTIONS, THEN CALCULATED)

The following tables and graphs were created by combining the given data for accessions, promotions, and losses with the Personnel Flow Function. The initial results are shown in Table 2 and Figure 7. They appear in bold in the following tables. All values not in bold were calculated using the technique in the title of the table. All optimal values for α and β were calculated and applied. The maximum and minimum projected values were consolidated in a final table to show the range of predictions from the different models.

	= maximum value in consolidated data
	= minimum value in consolidated data

Figure 36. Legend for Consolidation of Results

Year	2LT	1LT	CPT	MAJ	LTC	Total
2003	**2433**	**4292**	**9075**	**11505**	**7584**	34889
2004	**2599**	**4169**	**8134**	**10493**	**7359**	32754
2005	**2945**	**4204**	**6930**	**9622**	**7157**	30858
2006	2659	4222	8046	10540	7367	32834
2007	2970	4083	7246	9763	7205	31267
2008	3039	3946	6873	9331	6982	30171
2009	3070	3860	6854	9234	6923	29942
2010	2972	3855	6914	9254	6865	29859
2011	3027	3887	6880	9273	6923	29990
2012	3023	3868	6883	9254	6904	29930

Table 32. Overall Endstrength Forecasts (Three-Year Moving Average)

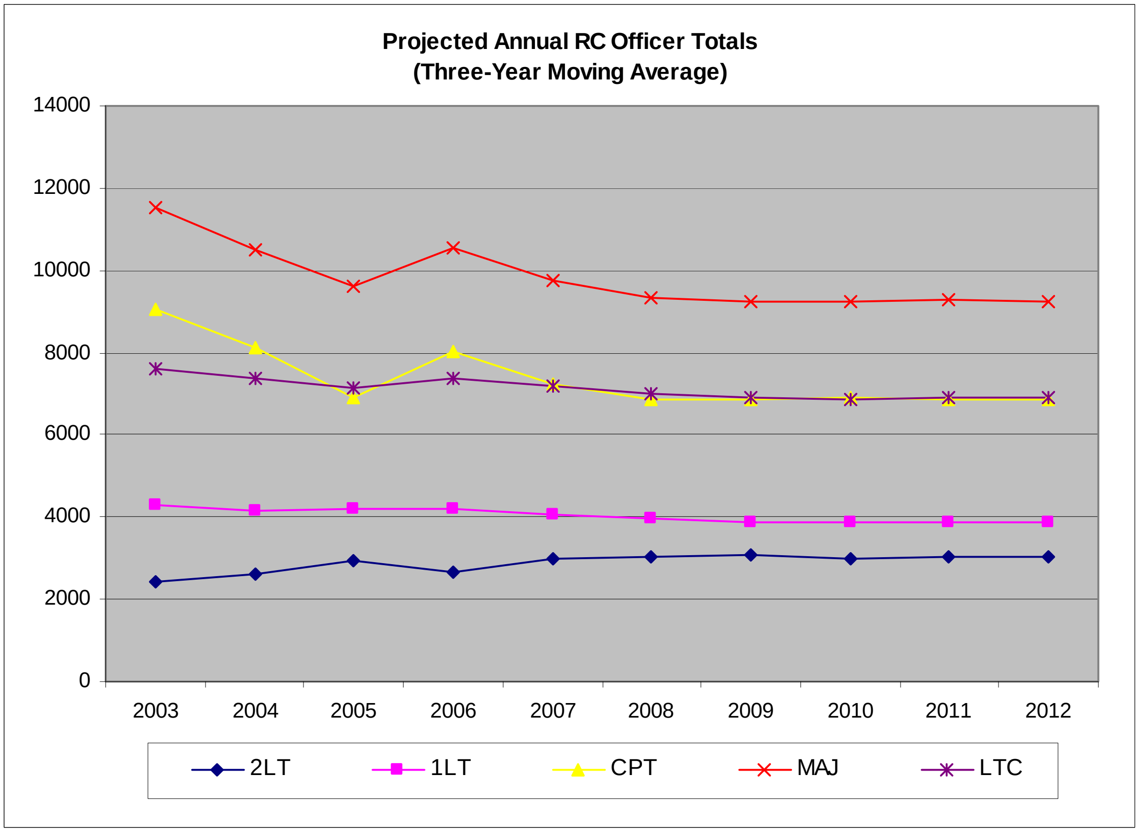

Figure 37. Overall Endstrength Forecasts (Three-Year Moving Average)

Year	2LT	1LT	CPT	MAJ	LTC	Total
2003	**2433**	**4292**	**9075**	**11505**	**7584**	34889
2004	**2599**	**4169**	**8134**	**10493**	**7359**	32754
2005	**2945**	**4204**	**6930**	**9622**	**7157**	30858
2006	**3365**	**3877**	**6675**	**9174**	**7098**	30189
2007	**2806**	**3758**	**7014**	**9197**	**6690**	29465
2008	3586	3380	4775	7031	6153	24925
2009	3737	3244	4217	6437	5948	23583
2010	3888	3108	3659	5844	5743	22242
2011	4039	2972	3101	5250	5538	20901
2012	4190	2836	2543	4657	5334	19559

Table 33. Overall Endstrength Forecasts (Linear Regression)

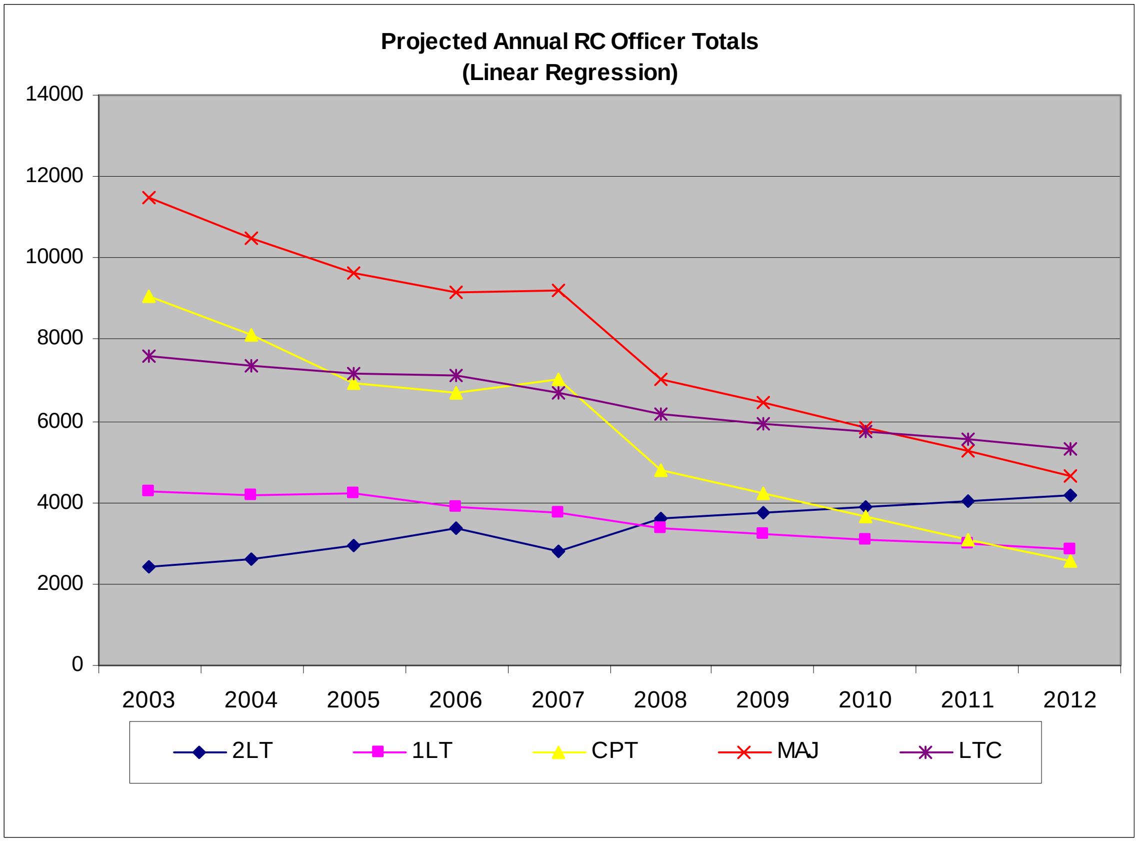

Figure 38. Overall Endstrength Forecasts (Linear Regression)

Year	2LT	1LT	CPT	MAJ	LTC	Total
2003	**2433**	**4292**	**9075**	**11505**	**7584**	34889
2004	**2599**	**4169**	**8134**	**10493**	**7359**	32754
2005	**2945**	**4204**	**6930**	**9622**	**7157**	30858
2006	**3365**	**3877**	**6675**	**9174**	**7098**	30189
2007	3378	3940	6322	8881	7008	29529
2008	3606	3877	6041	8632	6958	29114
2009	3705	3799	5989	8516	6938	28947
2010	3721	3833	5846	8414	6904	28719
2011	3819	3788	5789	8343	6894	28633
2012	3828	3781	5765	8308	6884	28566

Table 34. Overall Endstrength Forecasts (Four-Year Log Model)

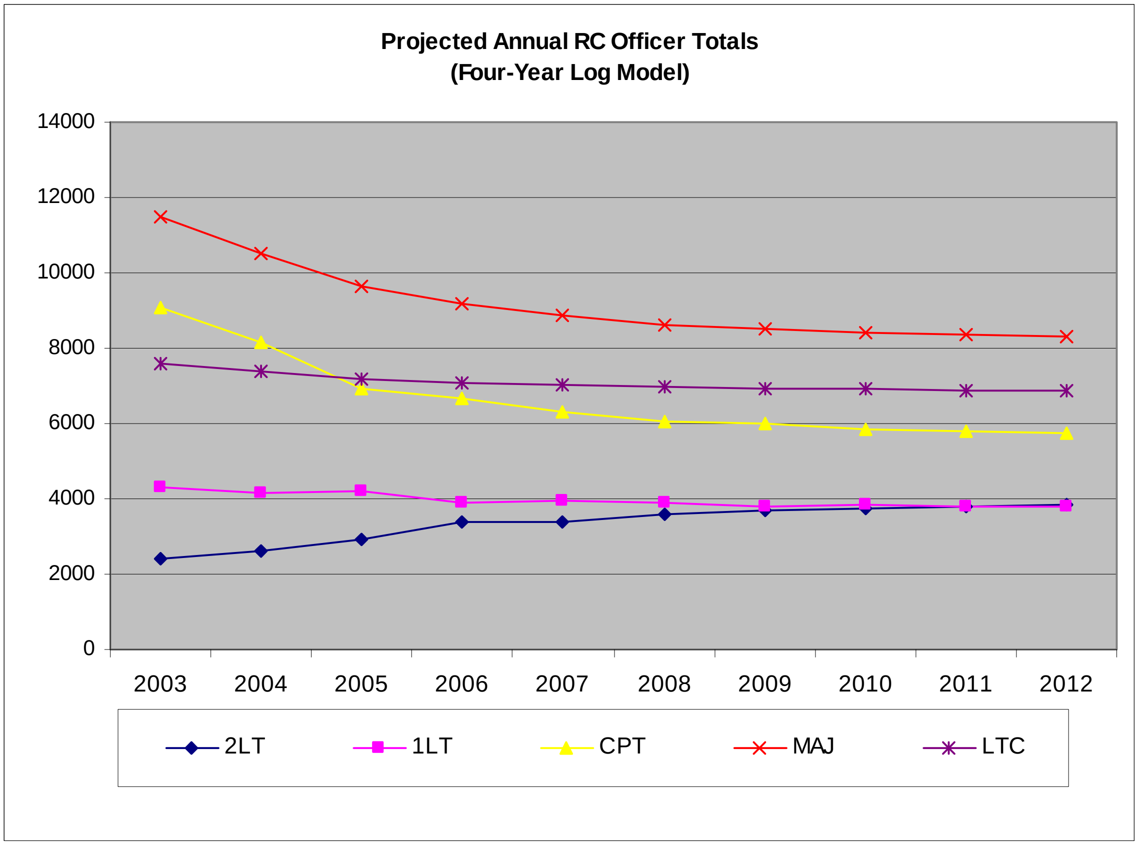

Figure 39. Overall Endstrength Forecasts (Four-Year Log Model)

Year	2LT	1LT	CPT	MAJ	LTC	Total
2003	**2433**	**4292**	**9075**	**11505**	**7584**	34889
2004	2433	4292	9075	11505	7584	34889
2005	2567	4169	8134	10493	7359	32722
2006	2871	4204	6930	9622	7157	30784
2007	3269	3877	6675	9174	7098	30093
2008	2896	3758	7014	9197	6690	29555
2009	2896	3758	7014	9197	6690	29555
2010	2896	3758	7014	9197	6690	29555
2011	2896	3758	7014	9197	6690	29555
2012	2896	3758	7014	9197	6690	29555

Table 35. Overall Endstrength Forecasts (Exponential Smoothing)

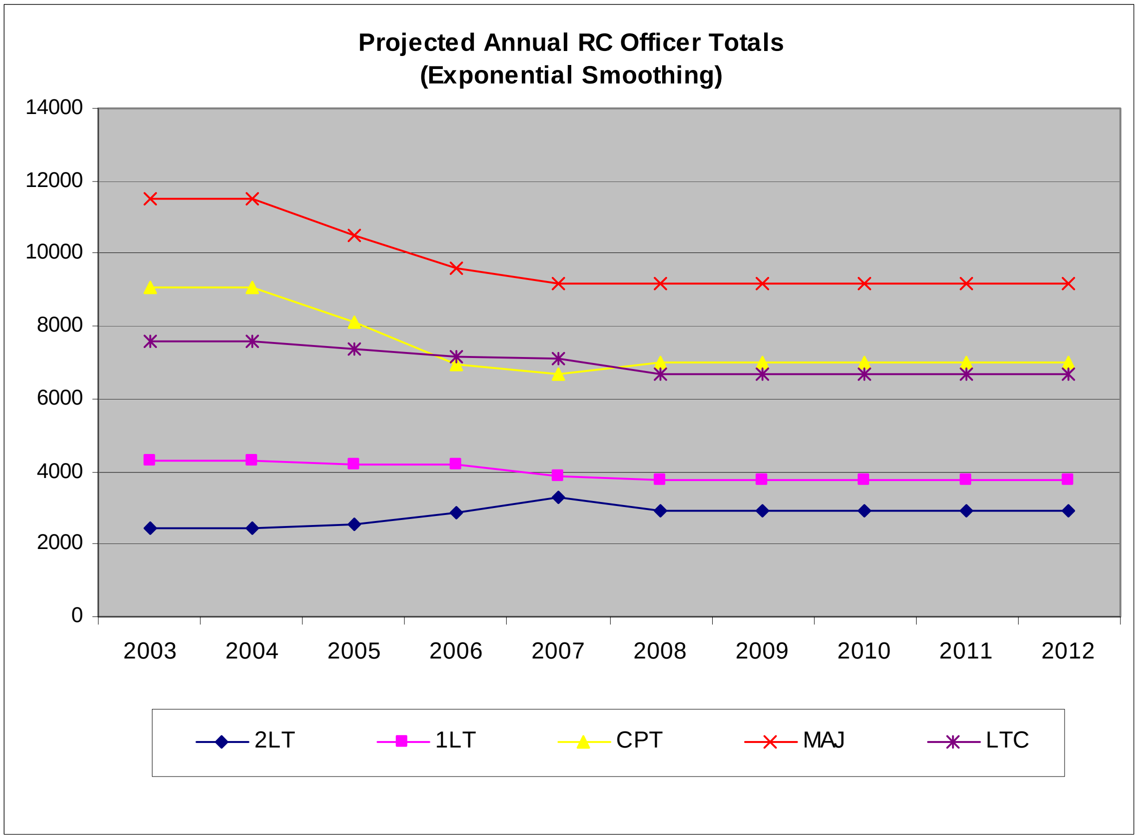

Figure 40. Overall Endstrength Forecasts (Exponential Smoothing)

Year	2LT	1LT	CPT	MAJ	LTC	Total
2003	**2433**	**4292**	**9075**	**11505**	**7584**	34889
2004	2765	4113	8398	10251	7300	32826
2005	2931	4020	7383	9808	7129	31271
2006	3097	3997	6052	9132	6938	29216
2007	3263	3809	5972	8558	6846	28448
2008	3429	3658	6603	8455	6529	28674
2009	3595	3535	6192	8108	6319	27749
2010	3761	3412	5781	7761	6109	26825
2011	3927	3289	5371	7415	5899	25901
2012	4093	3166	4960	7068	5689	24977

Table 36. Overall Endstrength Forecasts (Holt Smoothing)

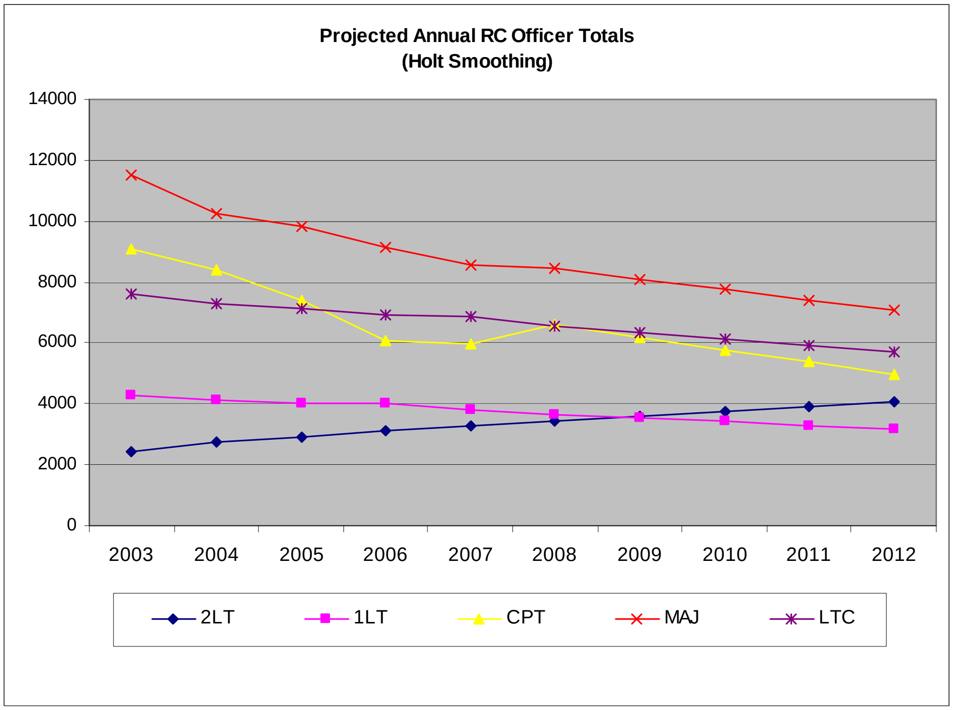

Figure 41. Overall Endstrength Forecasts (Holt Smoothing)

Year	2LT (MAX)	1LT (MAX)	CPT (MAX)	MAJ (MAX)	LTC (MAX)	Total
2008	3606	3946	7014	9331	6982	30879
2009	3737	3860	7014	9234	6938	30783
2010	3888	3855	7014	9254	6904	30915
2011	4039	3887	7014	9273	6923	31137
2012	4190	3868	7014	9254	6904	31229

Table 37. Maximum Values of Overall Endstrength Forecasts

Year	2LT (MIN)	1LT (MIN)	CPT (MIN)	MAJ (MIN)	LTC (MIN)	Total
2008	2896	3380	4775	7031	6153	24235
2009	2896	3244	4217	6437	5948	22743
2010	2896	3108	3659	5844	5743	21250
2011	2896	2972	3101	5250	5538	19758
2012	2896	2836	2543	4657	5334	18265

Table 38. Minimum Values of Overall Endstrength Forecasts

APPENDIX F OVERALL ENDSTRENGTH PROJECTIONS (CALCULATED IN SECTIONS, THEN COMBINED)

The following tables and graphs were created by applying each of the models to the data for accessions, promotions, and losses then combining the results using the Personnel Flow Function. All bold numbers are the computed data totals from the given data points. All other values were calculated using the technique in the title of the table. All optimal values for α and β were calculated and applied. The maximum and minimum projected values were consolidated in a final table to show the range of predictions from the different models.

(yellow)	= maximum value in consolidated data
(orange)	= minimum value in consolidated data

Figure 42. Legend for Consolidation of Results

Year	2LT	1LT	CPT	MAJ	LTC	Total
2003	**2433**	**4292**	**9075**	**11505**	**7584**	34889
2004	**2599**	**4169**	**8134**	**10493**	**7359**	32754
2005	**2945**	**4204**	**6930**	**9622**	**7157**	30858
2006	3219	4222	5925	8882	7076	29322
2007	3424	4117	5177	8117	6913	27748
2008	3552	4012	4814	7654	6635	26667
2009	3608	3861	4730	7326	6332	25857
2010	3648	3735	4651	7026	5948	25008
2011	3723	3607	4476	6662	5627	24094
2012	3779	3472	4363	6331	5291	23237

Table 39. Overall Endstrength Forecasts (Three-Year Moving Average)

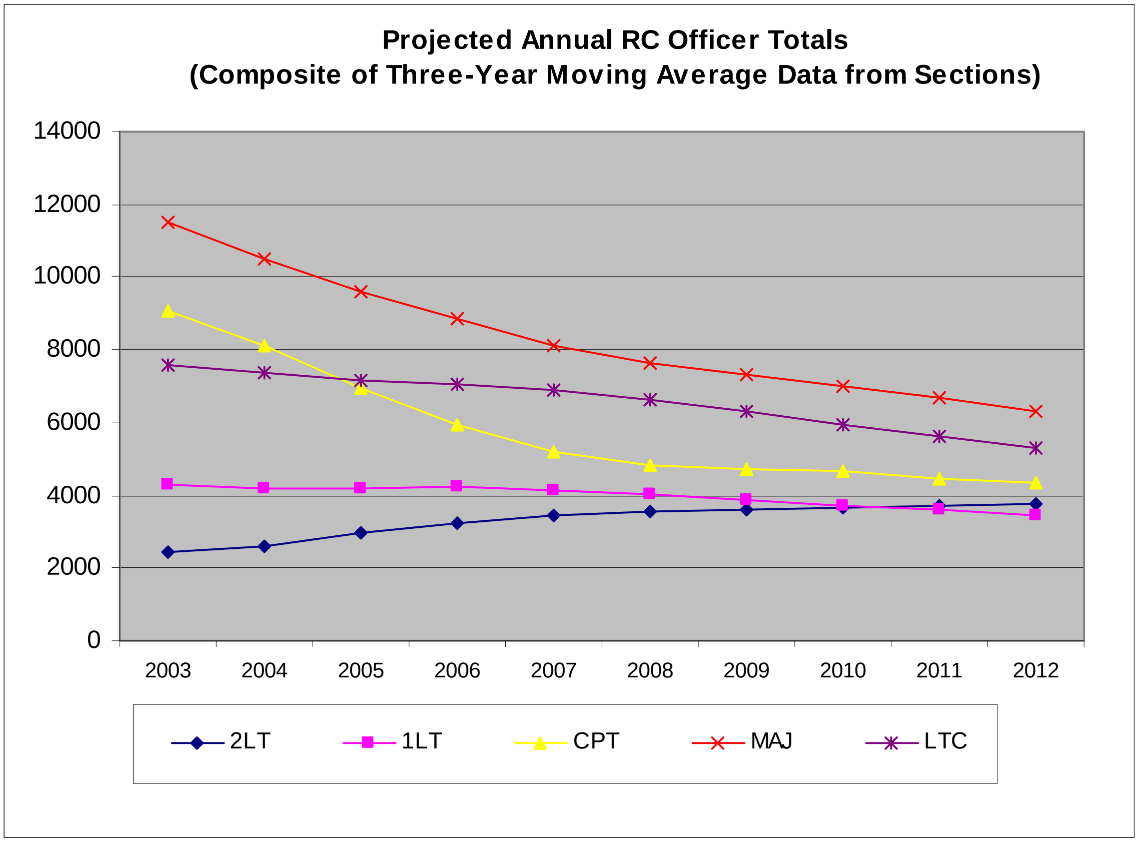

Figure 43. Overall Endstrength Forecasts (Three-Year Moving Average)

Year	2LT	1LT	CPT	MAJ	LTC	Total
2003	**2433**	**4292**	**9075**	**11505**	**7584**	34889
2004	**2599**	**4169**	**8134**	**10493**	**7359**	32754
2005	**2945**	**4204**	**6930**	**9622**	**7157**	30858
2006	**3365**	**3877**	**6675**	**9174**	**7098**	30189
2007	**2806**	**3758**	**7014**	**9197**	**6690**	29465
2008	2498	3462	7359	9054	6243	28616
2009	2041	3094	8015	9039	5694	27884
2010	1437	2653	8982	9153	5044	27269
2011	684	2140	10259	9395	4292	26771
2012	-217	1555	11847	9766	3439	26390

Table 40. Overall Endstrength Forecasts (Linear Regression)

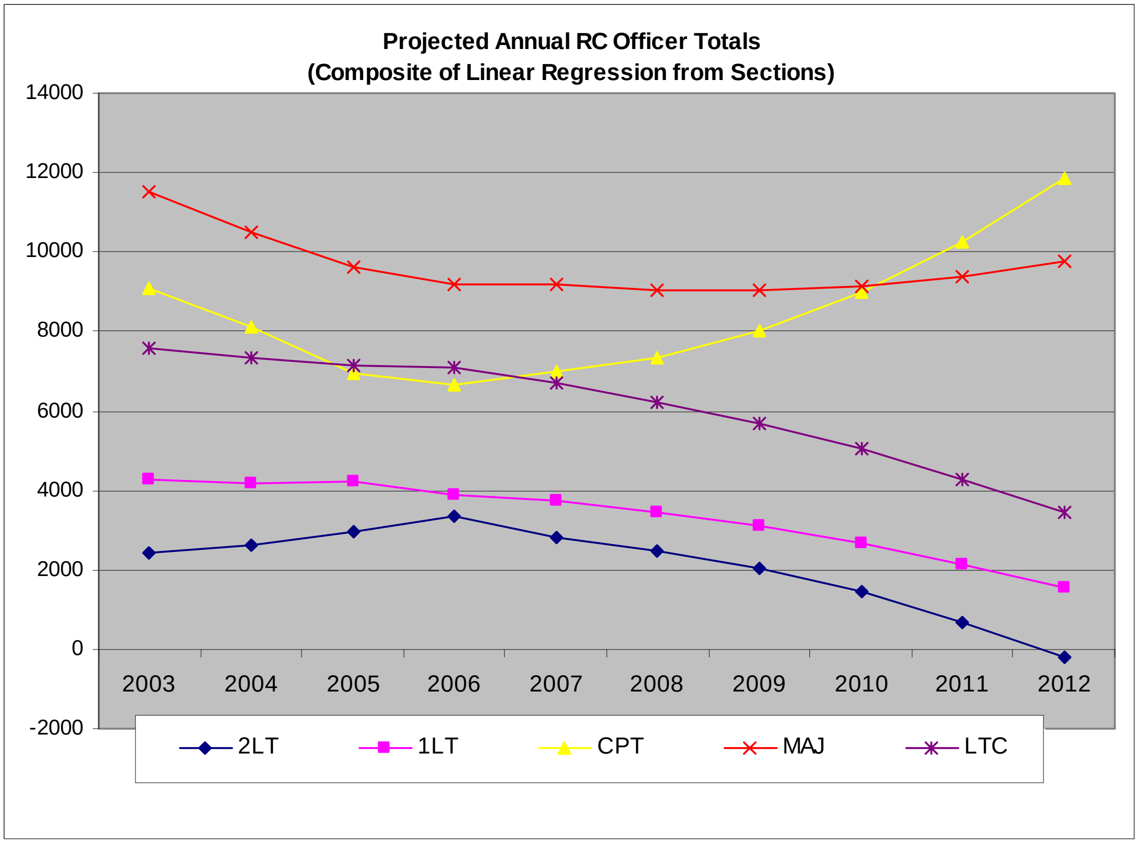

Figure 44. Overall Endstrength Forecasts (Linear Regression)

Year	2LT	1LT	CPT	MAJ	LTC	Total
2003	**2433**	**4292**	**9075**	**11505**	**7584**	34889
2004	**2599**	**4169**	**8134**	**10493**	**7359**	32754
2005	**2945**	**4204**	**6930**	**9622**	**7157**	30858
2006	**3365**	**3877**	**6675**	**9174**	**7098**	30189
2007	3772	3001	6695	8436	6818	28722
2008	3653	2674	6905	8423	6508	28163
2009	3343	2001	7848	8586	6207	27986
2010	2689	1566	8849	8786	5849	27739
2011	2362	886	9915	8990	5538	27691
2012	1803	137	11303	9254	5218	27716

Table 41. Overall Endstrength Forecasts (Four-Year Log Model)

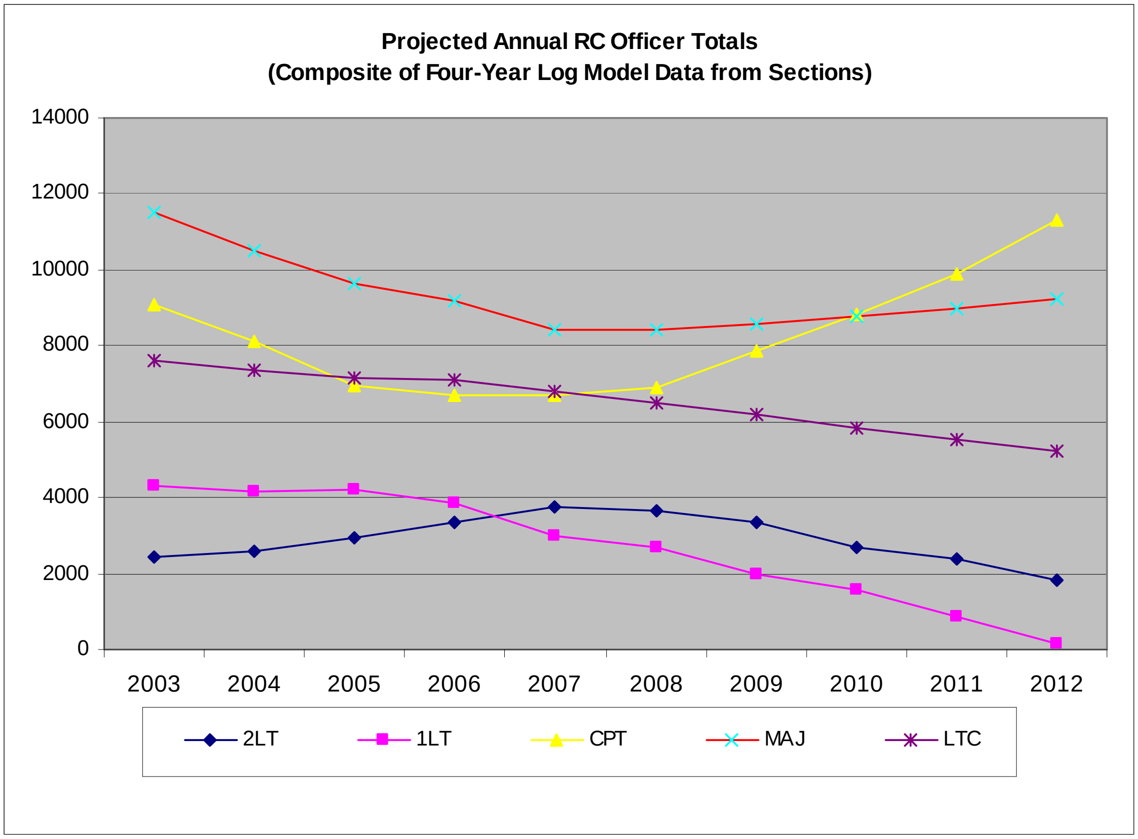

Figure 45. Overall Endstrength Forecasts (Four-Year Log Model)

Year	2LT	1LT	CPT	MAJ	LTC	Total
2003	**2433**	**4292**	**9075**	**11505**	**7584**	34889
2004	2742	4433	8204	11167	7767	34313
2005	3045	4330	7212	10469	7883	32939
2006	3300	4222	6020	9783	7869	31194
2007	3540	3970	5741	9163	7757	30171
2008	3678	3376	6053	9047	7173	29327
2009	3678	3376	6053	9047	7173	29327
2010	3678	3376	6053	9047	7173	29327
2011	3678	3376	6053	9047	7173	29327
2012	3678	3376	6053	9047	7173	29327

Table 42. Overall Endstrength Forecasts (Exponential Smoothing)

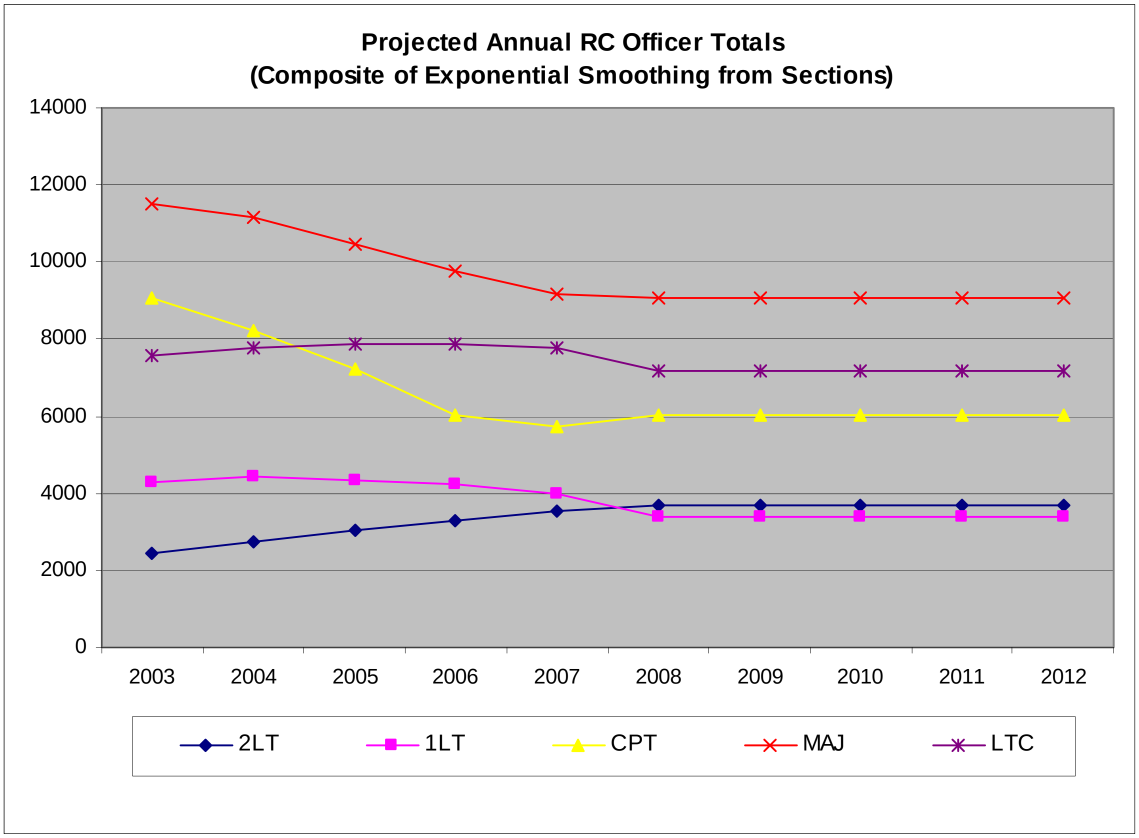

Figure 46. Overall Endstrength Forecasts (Exponential Smoothing)

Year	2LT	1LT	CPT	MAJ	LTC	Total
2003	**2433**	**4292**	**9075**	**11505**	**7584**	34889
2004	2498	4165	8248	10702	7374	32987
2005	2463	3914	7164	9331	6975	29848
2006	2220	3787	5714	8185	6496	26402
2007	1841	3125	5692	7976	6315	24949
2008	1198	2334	6569	8772	5863	24736
2009	350	1348	8034	10283	5317	25331
2010	-705	167	10086	12508	4676	26733
2011	-1965	-1208	12726	15448	3941	28942
2012	-3432	-2778	15955	19103	3111	31959

Table 43. Overall Endstrength Forecasts (Holt Smoothing)

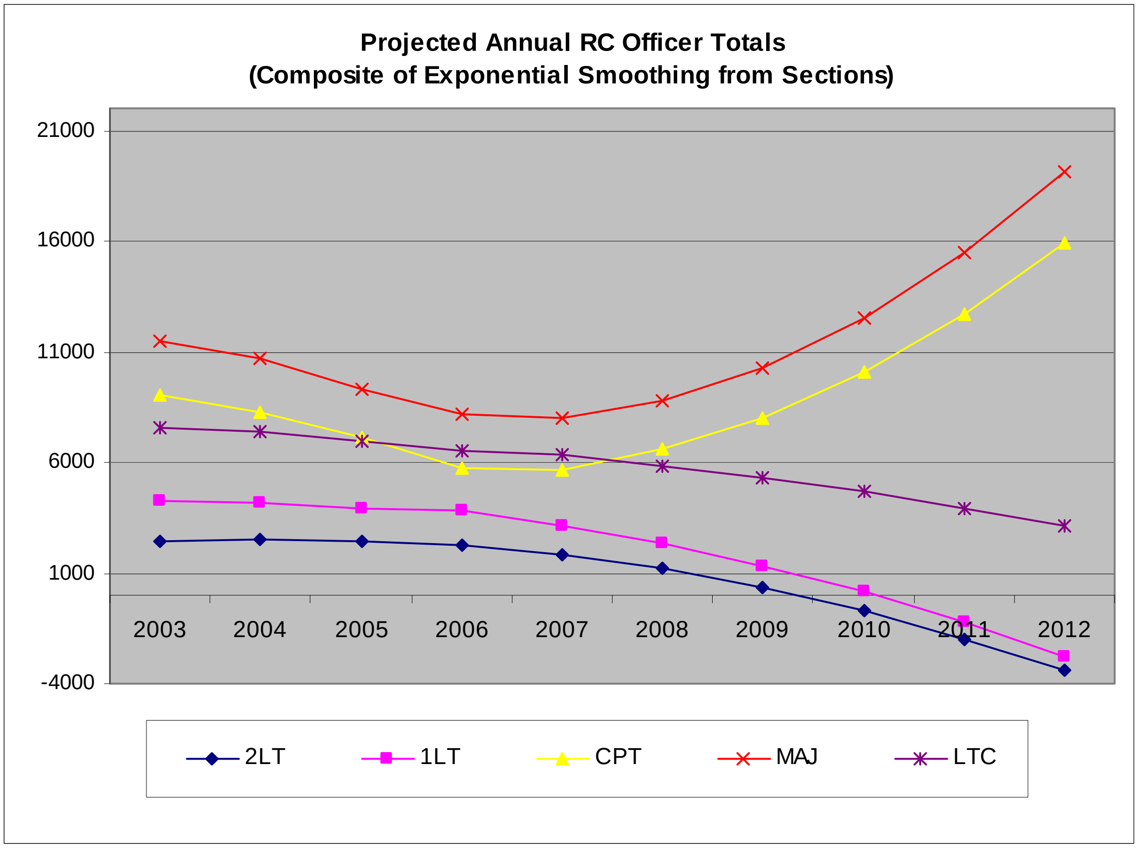

Figure 47. Overall Endstrength Forecasts (Holt Smoothing)

Year	2LT (MAX)	1LT (MAX)	CPT (MAX)	MAJ (MAX)	LTC (MAX)	Total
2008	3678	4012	7359	9054	7173	31277
2009	3678	3861	8034	10283	7173	33028
2010	3678	3735	10086	12508	7173	37180
2011	3723	3607	12726	15448	7173	42677
2012	3779	3472	15955	19103	7173	49482

Table 44. Maximum Values of Overall Endstrength Forecasts

Year	2LT (MIN)	1LT (MIN)	CPT (MIN)	MAJ (MIN)	LTC (MIN)	Total
2008	1198	2334	4814	7654	5863	21863
2009	350	1348	4730	7326	5317	19071
2010	-705	167	4651	7026	4676	15816
2011	-1965	-1208	4476	6662	3941	11905
2012	-3432	-2778	4363	6331	3111	7596

Table 45. Minimum Values of Overall Endstrength Forecasts

Year	2LT	1LT	CPT	MAJ	LTC	Total
2003	2433	4292	9075	11505	7584	34889
2004	2658	4135	8269	10911	7543	33516
2005	2824	3854	7206	9919	7354	31157
2006	2793	3697	5770	9069	7071	28401
2007	2705	3005	5758	8591	6872	26931
2008	2206	2184	6648	8973	6405	26415
2009	1458	1138	8138	9863	5806	26402
2010	462	-133	10228	11260	5076	26892
2011	-782	-1628	12919	13165	4214	27887
2012	-2275	-3348	16210	15577	3221	29386

Table 46. Overall Endstrength Forecasts using Combined Totals from Best Fit Models

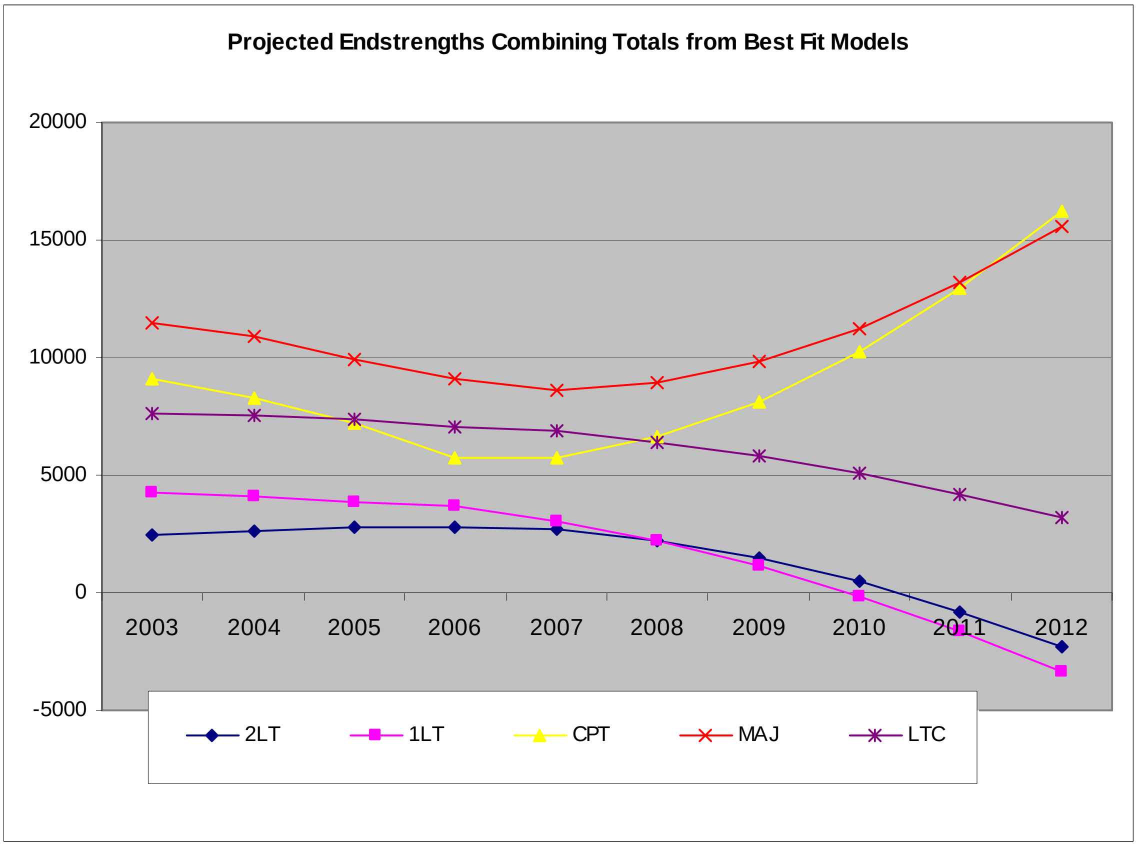

Figure 48. Projected Endstrengths using Combined Totals from Best Fit Models

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